THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
Workshop System	1009
Electric Trolley Omnibuses	1010
Cotton Mill Driving	1010
Electric Lighting in the City	1010
Public Lighting in the City of London (*illus.*)	1011
Recent Developments in Textile Mill Design and Operation: Notably as Regards Electrification (*illus.*)	1013
Correspondence:—	
Combined Destructor and Electricity Works	1015
Commercial Training of the Engineer	1016
Our Legal Query Column	1017
Legal	1017
New Electrical Devices, Fittings and Plant (*illus.*)	1022
Business Notes	1023
Electric Driving of Textile Machinery (*illus.*)	1027
Notes	1034
City Notes	1036
Market Quotations...	1038
Stocks and Shares	1038
Share List of Electrical Companies	1039
Reviews	1041
Electrical Work from Chicago to the Pacific	1042
Proceedings of Institutions:—	
Electric Heating and Cooking	1043
Control of Electric Winding Engines	1044
Submarine Cables for Long-Distance Telephone Circuits (*illus.*)	1045
A Novel Tram-Rail Cleaning Method (*illus.*)	1047
Foreign and Colonial Tariffs on Electrical Goods	1047
New Patents Applied For, 1910	1048
Abstracts of Published Specifications	1048
Contractors' Column ... ... Advertisement pages xxiv and xxvi	

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WORKSHOP SYSTEM.

THERE are many workshops in the electrical industry which produce goods intended for use in building up machinery, or for fitting with other work to form a part of some greater unit, such as a switchboard or a tramcar. In these shops much of the work is of the repetition order, yet after this there is usually so great a variety of orders differing in size, weight and design, that it is not an easy matter so to arrange the output of any one department as to give satisfaction to every customer.

The very fact of the orders being composed largely of a multitude of entirely different sizes and quantities increases the difficulty in acquiring an automatic and methodical system of delivery. The usual result is, therefore, that while the orders of the more important customers are looked after fairly well and delivery is made in a reasonable time, the bulk of the smaller and relatively less important orders are dealt with in a manner which is not always satisfactory, because delay often takes place which is both irritating and unwarrantable. Here and there orders are neglected until the customer begins to inquire for them, and this creates a bad impression.

Most business people are satisfied with a fair delivery, providing they can rely upon promises being kept, but when orders are overlooked in this manner, the prestige of the firm in question cannot fail to suffer in the eyes of the buyer. The order department staff have not time to notice such delays, and so long as they can obtain such information from the foreman as will satisfy inquiries, are often content to let well alone, until the complaint comes along.

We do not suppose that it will be seriously contested, however, if we say that to most firms the small regular orders are of as great importance as the larger ones, and that it is just as essential that they should be executed within reasonable time limits. Experience shows that urgent orders should be given such preference as is necessary to complete them in the given time, and after that the rule should be to give all orders their proper turn, in so far as it is possible and economically feasible to do so.

Above all, one thing should be most carefully avoided, the necessity of promising a job a second time after having failed in the first promise. No more promises of delivery ought to be made for any period than can reasonably be expected to be fulfilled. If this is avoided the rest is easy, though it lies in the hands of the clerical staff to arrange so that while doing the best for their customers, they do not break the back of the willing, but sometimes overladen foreman. To secure this end, a method which has been used on more than one occasion by one of our contributors, has been so successful that it may be of service to others. Its simplicity is its only fault. A list of all promises made should be carefully kept in

duplicate. The foreman has one copy and the order office another. Each morning that list should be revised, new promises and requirements being entered, and finished orders crossed off. Further, the order books or files should be periodically inspected, say fortnightly, and a list of the old orders, if any, made out. This brings to the notice of those concerned the fact that there has been delay, and such overdue orders can at once be cleared out. By this means it will be found that an automatic rotation in the handling of orders is secured, the foreman knows at any time exactly how far he is committed for the next few days, and he is able to make fresh promises with something near to certainty. The correspondence department is able to supply reliable information to clients, and its work is lessened, since there will be less correspondence about neglected orders. Should it be found necessary, separate lists for the larger customers can be kept, as well as one for the small buyers. The method is the same whatever the scale of operation, and the effect is identical.

For more complicated processes of manufacture, where the manufactured article has to go through three or four shops before completion, the system requires to be worked out in accordance with the length of time required in each department, and being rather more elaborate, would naturally require a little more attention in the office. We have seen cases where the system of deliveries had been brought to a fine art, in that each works ticket or sheet for a certain article had stamped upon the reverse side the dates when that article was due in each department. It has been stated as an objection to this plan that as almost every other order had the dates thus given, the object desired was defeated by the frequency with which it was used, because the foremen were apt to regard the system as rather overdone. As outlined above, however, this system would seem to be simpler and more effective, and may be used with good results by any who desire to place the prompt delivery of their manufactures upon a systematic and well-defined basis, and so ensure for themselves a reputation for reliability in despatch.

Electric Trolley Omnibuses.

The question of railless electric traction or trolley omnibuses is at present attracting increased attention in Germany as well as in Great Britain. It was recently resolved to introduce the system in the Berlin suburb of Schoneberg, and now the subject is also being closely considered in the suburb of Gross Lichterfeld. The Schoneberg town authorities have appointed a committee to make a preliminary examination of the method, which is also to be studied as in operation at Vienna and Bremen, and this decision has induced Minister von Dallwitz to dispatch two police experts to Vienna to gain information. The trolley omnibus was given a trial in Berlin several years ago, but was abandoned on the ground of being quite unreliable at that time. Since then the juvenile defects seem to have been overcome, as the system is said to have very well answered the purpose in Vienna and Bremen. A new side of the question, which, as we have stated, will probably also come forward in England, relates to the wear of the roads caused by the use of railless electric traction and the possibility of the owners being required to make contributions towards the cost of maintaining the roads. This problem has already arisen in Wurtemberg as a result of the work of installing two trackless lines from (1) Ludwigsburg to Aldingen and Bad Hoheneck and from (2) Heilbronn to Boekingen. The State authorities have sought to make the promoters liable to pay, but the latter declare that they would rather drop the schemes than acknowledge any liability to make contributions towards the cost of road maintenance. It has, however, been arranged in the Heilbronn-Boekingen case that the company shall be permitted to erect the posts for carrying the overhead lines on the State roads, and observations are to be made of the traffic on the route for a period of 1½ years. At the end of that time the State reserves the right of drawing upon the company for a contribution in the event of the cost of road maintenance due to the use of trolley omnibuses exceeding a sum that has already been fixed. It is expected that a similar arrangement will be made in regard to the Ludwigsburg line, which will extend over a much longer stretch of road.

Cotton Mill Driving.

The article on the Ray Mills, which we publish elsewhere in this issue, should be read with profound satisfaction by the advocates of the electric drive. Its great significance lies in these facts :—Six years ago the Victor Mill was started with an up-to-date installation of steam-rope driving ; two years later the Premier Mill was equipped with electrical transmission, power being derived from an external source—this was regarded as being somewhat in the nature of an experiment ; and two years ago the Ray Mills were also provided with electrical transmission. Now, it cannot be supposed that the hard-headed Lancashire mill-owners do not know their business from A to Z ; hence the fact that, having tried electricity, they have continued to adopt it is the most satisfactory proof that could possibly be desired as to the superiority of the electrical system, from the commercial point of view, which is the only consideration that really weighs with the user. It is gratifying, too, to note that even in the Victor Mill, which is steam-driven, large electric motors have been installed instead of steam to drive the 'extensions, and that they have worked for two years without a hitch (though there is no occasion for surprise in the latter fact).

We do not wish to labour the point. The facts unmistakably confirm the opinion expressed by the owners of the Mersey Mills, which we have quoted—that electrical driving increases the output and improves the quality of the product, and that the repairs required by the machines are trifling. Electrical engineers should need no urging to keep these valuable features before the eyes of their prospective clients.

Electric Lighting in the City.

In view of the breathless eagerness of the gas interests and their willing allies in the daily Press to propagate the belief that "London is going back to gas," the particulars given elsewhere in this issue regarding the recent developments in the City of London will be welcomed by the electrical fraternity. Although the main streets of the City have for years been lighted with arc lamps, the City Corporation has not always shown a disposition to encourage the use of electricity ; indeed, we have had occasion to complain of distinct evidences of partiality towards the rival illuminant, as witness the report of the Commissioners in favour of a system of gas lighting which they had not even seen in the course of their travels. However, the Corporation has now permitted the City company to demonstrate what can be done with up-to-date arc and incandescent lamps and fittings, with results which cannot fail to impress the impartial observer. Granted that street gas lamps have made great advances in recent years—so have electric lamps ; and given a fair field and quotations on a commercial basis, electricity now has nothing to fear from any rival except the sun.

Apropos of gas, the danger of employing this means for lighting trains is again exemplified by the disaster at New York, which, it is reported, originated with a leak from a gas tank on a train. Particulars are given in our "Railway Notes."

PUBLIC LIGHTING IN THE CITY OF LONDON.

The first practical electric lighting of the City streets on a large scale may be said to date from the Brush Co.'s proposal of 1885. After 13 years of deliberation and experimental trials, in 1890-91 the Brush Co. and the Laing, Wharton & Down Co. obtained definite contracts and provisional orders within the City, which required that the lighting of the main thoroughfares by arc lamps should be completed by the end of 1893. The two companies concerned transferred their obligations to the City of London Pioneer Co., which in turn was absorbed by the present City of London Electric Lighting Co. in July, 1891. The public lighting contracts at this date provided for the installation of over 500 arc lamps, and the City of London Electric Lighting Co. carried out the completion of this work; the posts, fittings, lamps and lanterns were those recommended by the Commissioners' advisers and approved by the Corporation.

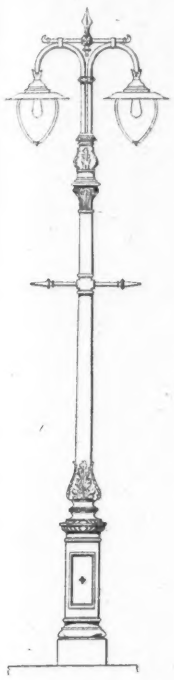

Fig. 1.—Incandescent Lamp Standard.

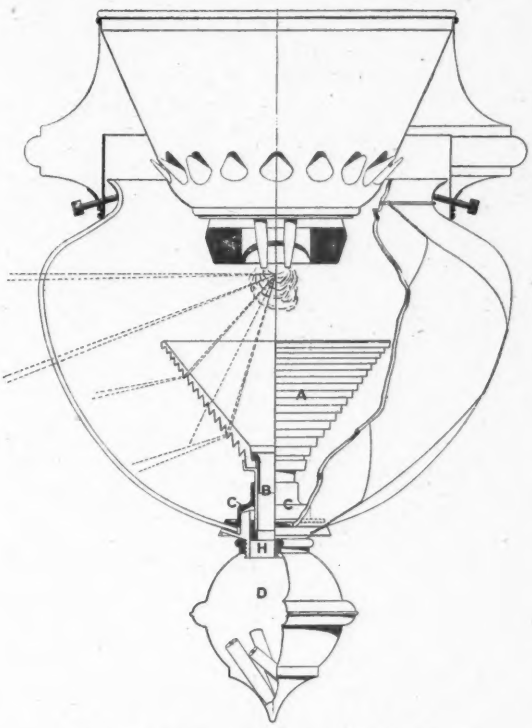

Fig. 2.—Oriflamme Globe, showing Peard Prismatic Reflector.

Since the date of this installation, which comprised the electric arc lighting of all the main thoroughfares in the City, the City of London Electric Lighting Co. has continued to take a most active interest in all the many developments of arc and other lamps suitable for public lighting requirements. For this purpose extensive test rooms have been provided at the Bankside Works of the company, and fully equipped with every requisite form of apparatus for examining the photometric value and practical utility of each new type of lamp brought out, including open arcs, enclosed arcs, Nernst and glow lamps of every description and make; and in latter years the progress and merits of open and enclosed flame arcs have been the subject of extensive investigation. Trials of all the many modifications of new lamps and carbons have been continuouly carried out, but although many of these lamps have been found to possess excellent photometric qualities, serious difficulties have arisen tending to prevent their immediate commercial application for public lighting purposes on a large scale, owing to the operative costs and difficulties in connection with the supply of a regular and suitable grade of carbon.

It was not until about 1903, when the magazine flame arc became a commercial success, that it was found feasible to advocate any material change in the open arc lamps, which had so far been used for the public lighting of the City.

At this date defects still existed in connection with the practical application of flame arcs, not the least being the question of carbon supplies, and deterioration of the lamp due to fumes. The City Company, however, after extensive trials at their works, decided to practically apply these lamps, and in 1904 erected the flame arcs on the front of the Mansion House, these being followed early in 1905 by the erection of similar lamps in Poultry and Mansion House Place.

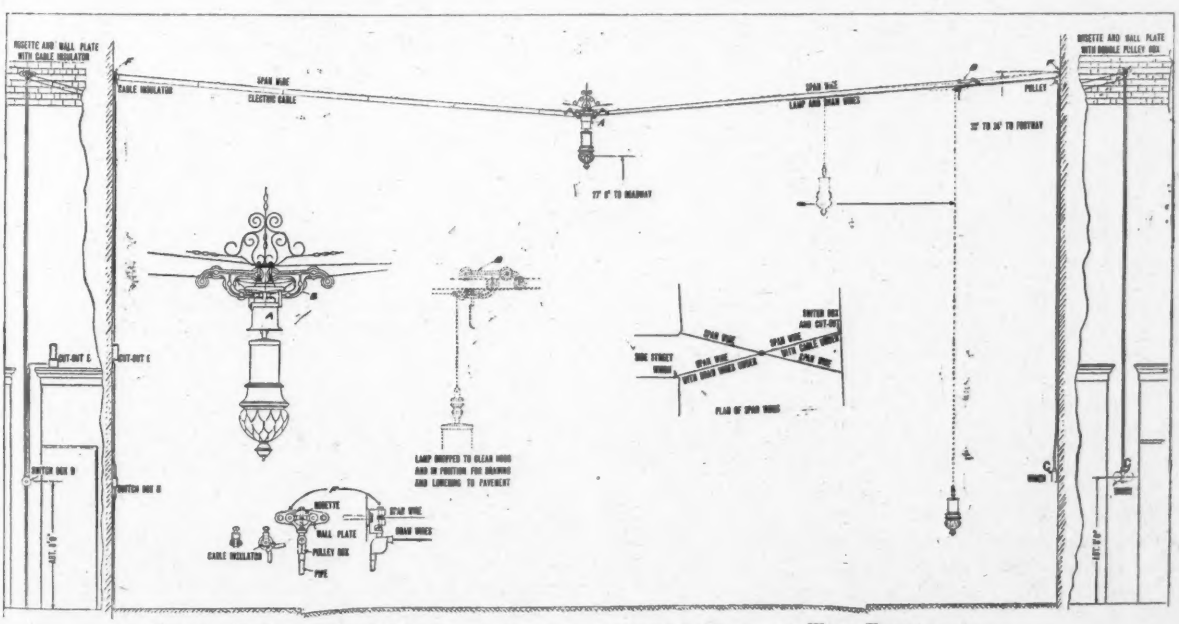

Fig. 3.—System of Lamp Suspension, Cheapside, showing details of Wall Fittings, &c.

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The material increase in the light afforded by these lamps, and the generally expressed approval of their appearance in the streets, led to a further demonstration of flame lighting in October, 1905, at Blackfriars Bridge approach.

These demonstrations resulted in the City Company obtaining a contract from the Corporation for lighting the Central Meat Market, Smithfield, and the old open arcs being replaced by 10-ampere Oriflamme lamps in May, 1907. In this year the City Company also asked for and obtained the permission of the Corporation to demonstrate the value of these lamps by replacing the old 10-ampere lamps in City lanterns on the posts in Holborn, by Oriflamme arcs with opalescent globes supported on swan-neck brackets, the instalment of these lamps being completed by November, 1907; and notwithstanding the fact that the City Company had provided all the new capital required in connection with the replacement of the old lamps, and had greatly improved the lighting of the street, they were able to reduce the annual charge per lamp to the Corporation from the contract price of £26 to £17 10s.

Although these lamps met with general approval and were kept in operation, further progress in the improved lighting of the streets was held over pending the deliberations of the Corporation and the various experimental trials with H.P. gas in several streets.

The superior qualities and commercial value of flame arc lighting in Smithfield Market, however, led to fresh contracts being entered into for lighting Billingsgate Fish Market in January, 1908, and Leadenhall Market in July, 1909.

Further improvements in flame arc lamps and flame carbons, coupled with the advent of metallic-filament lamps (making the application of glow lamps for minor street lighting both advantageous and practicable), rendered it possible for the City Company to lay before the Corporation further offers to demonstrate in a comprehensive manner the possibility of greatly improving the lighting of the City streets by electricity, together with a substantial reduction in the cost thereof. After lengthy consideration the Corporation allowed this work to proceed, and the following schemes were carried out and put in operation last month. For the details and illustrations we are indebted to Mr. Frank Bailey, chief engineer of the City of London Electric Lighting Co.

Central Suspension System, Cheapside and Watling Street Area.

Probably the chief merit of the central suspension system lies in the advantageous position, relative to cross streets, in which it enables lamps of high candle-power to be placed, at any desired height above the roadway.

As many of the most important and congested thoroughfares of the City are of insufficient width to permit of the central traffic rests necessary for the erection of high standards, the suspension system becomes the only possible method of arranging the lamps to the best advantage as regards economical illumination over a given area, embracing both main and side streets.

To demonstrate the superiority of flame arc lighting, as obtainable by the use of the latest improved magazine flame arc lamps in conjunction with a central suspension allowing the lamps to be lowered to the sidewalk for trimming and attention, the City Company, by permission of the Corporation, have recently completed the lighting of the main and side streets and courts enclosed within the area bounded by Cheapside, St. Paul's Churchyard, Watling Street and Bow Lane.

For this purpose, 10 flame arc lamps have been suspended over the centre of Cheapside; five of these, comprising the lamps which are situated immediately opposite the junction of side streets, remain in lighting from sunset to sunrise, the intermediate five lamps being extinguished at midnight.

As is well known, Cheapside, both during the day and early hours of the evening, is one of the most congested thoroughfares in London as regards both vehicular and pedestrian traffic. The advantage of the new arrangement of lamps is thus apparent; a very high degree of illumination throughout the street is provided during hours of heavy traffic, while both the main and the side streets are adequately lighted throughout the whole night.

Four flame arc lamps of the same type are suspended in a similar manner in Watling Street, at the junction of the cross streets; the latter are thus illuminated at one end by the Cheapside lamps and at the other by those in Watling Street. Watling Street has, in addition, two high candle-power lanterns containing metallic-filament lamps of 300 C.P. centrally suspended in the long intervals between the arcs.

The lighting of the side streets, passages and courts adjoining is augmented where necessary by 12 metallic-filament lamps of from 75 to 100 C.P., enclosed in fittings supported from side brackets of the same type as those described below for Paternoster Row.

On the small traffic rest at the west end of Cheapside, by Peel's Statue, is a pilot standard having two 100-C.P. metallic-filament lamps, supported in fittings attached to a double-bracket top of a similar pattern to those to be described for Farringdon Street (fig. 1).

These 29 new lamps have displaced 49 lamps originally used for lighting the thoroughfares now illuminated, the old lamps comprising eight 10-ampere open arcs on side posts in Cheapside and 41 gas lamps in side streets and courts.

Owing to the increase in height, and the more effective positions of the new lamps, the total actual candle-power of which is more than double that of the nominal candle-power of the old lamps displaced, the illumination of the whole area embraced by this lighting has been vastly improved, particularly in the case of Cheapside, while the annual cost of lighting shows a very material reduction.

The width of Cheapside is about 60 ft., and the length lighted 973 ft. The width of Watling Street varies from 20 to 30 ft., the length lighted being 924 ft., making 1,897 ft. of main street lighted by the 14 arc lamps installed.

The length of the side streets, courts and passages also partly lighted by these arcs in combination with metallic-filament lamps, amounts to 2,475 ft., so that the total length of the thoroughfare illuminated by the combined arrangement of new lamps becomes 4,372 ft.

The height of the central suspension lamps is 27 ft. 6 in. to the roadway, and that of the tungsten lamps on brackets in the minor streets and courts, from 12 to 13 ft. from the footway.

The arc lamps are the latest pattern of Messrs. Oliver's 12½-ampere magazine flame lamp, having special carborundum economisers and other recent improvements. A new feature of these lamps is the prismatic reflectors designed and fitted by the City company. These each consist of a funnel-shaped glass dish A, screwed to a movable tubular stem B, supported by a special fitting C, attached to the bottom of the outer globe, which is of clear glass. Their function is to increase the candle-power of the lamps near the horizontal plane, thereby greatly adding to their effective power for street lighting purposes; they also enlarge the visible area of the light source, and screen the eye from the direct rays of the arc at all angles 35° below the horizontal. In addition, they serve a very useful purpose in materially reducing the deposit on the globe, all carbon-ends and dust passing throngh the reflector into a detachable copper ball fitting D, below the globe.

The general arrangement of these reflectors and fittings is shown in fig. 2. By their use an effective C.P. is obtained of 3,000 candles about and somewhat below the horizontal plane, while the mean hemispherical C.P. is maintained above 2,800 candles.

The special carbons burnt in these lamps give but a slightly golden tinted light, devoid of any excess of the yellow or red rays which are the cause of the somewhat glaring effect of many flame arc lamps. The result is a very cheerful and pleasant illumination, combined with an excellent light distribution in the street, the whole of the building frontages being brilliantly illuminated.

The adoption of the new prismatic reflectors, which have the effect of largely increasing the apparent area of the arc, permits the flame arc lamps to be run with clear outer globes, thus adding 20 per cent. to their efficiency; owing to their high candle-power in the horizontal direction they possess extraordinary penetrative power, even in the most foggy weather, this being particularly evidenced during the recent heavy ground fogs, when it was possible to see each of the

10 arc lamps in lighting when standing at the St. Paul's end of Cheapside.

With central lighting the reflection from the building frontages is of material assistance in illuminating the street, hence the value of a high horizontal candle-power apart from the improvement effected in the minimum illumination by the direct rays from the lamp.

The central suspension gear erected for the support of these lamps is that specially made for the purpose by the London Electric Firm, after numerous experiments and modifications made in conjunction with the City Company at their Bankside works. The present development embodies the many ingenious devices of the Croydon firm, and the whole combination has so far proved eminently satisfactory.

The general view of the cross span wire with lamp in its normal working position is shown by fig. 3. The central headpiece and weatherhood A contains the electric contact device and automatic coupling which holds the lamp when in position quite independently of the winch wires. This hood is rigidly attached to the two span wires crossing diagonally at the centre of the roadway, these main span wires (which consist of $\frac{5}{16}$ in. diameter compound steel ropes of the type used for aerial ropeway work) being secured at their ends to special rosettes mounted on wrought-iron wall plates F. The latter are each separately held to the building frontage by two 1-in. diameter Lewis bolts, cemented into the wall 11 in. apart. The lamp carriage B, shown separately at the left of the figure, is made to traverse one of the main span wires by the operation of the double-barrelled winch box C, shown on the right. This winch box contains two winding drums, one for supporting the carriage draw wire and the other the lamp lowering wire. These drums may be worked separately or together by means of an interlocking gear which is brought into action by pressing a button provided on the winch box. It is thus possible to lower the lamp any convenient distance from the central hood and maintain its height above the ground level until drawn into the required position for lowering, which can be done at any desired point.

The lamp and draw wires from the winch box to the span wire rosette are both enclosed within a 1-in. diameter Simplex steel tube, thus protecting both the building frontage and the wires from damage, grease or rust, and at the same time rendering it possible to keep the wires thoroughly coated with a suitable water-proofing lubricant.

The electric leads, consisting of a twin cable, rise at the opposite side of the roadway, crossing to the central hood below the span wire, to which the cable is attached by the usual hangers. This adds balance and a symmetrical appearance to the system. An isolating switchbox D is provided on this cable at a height of about 8 ft. from the ground, the automatic cut-out box (E) being placed in a convenient position above the shop frontages (see illustration to left of fig. 3). The whole of the cabling from the ground to the span wire is entirely enclosed in $1\frac{1}{4}$ in. diameter Simplex steel tubing.

Owing to the nature of the thoroughfare, the heavy traffic, and the variety and complexity of the shop frontages, the installation has been fraught with difficulties, and owing to the busy nature of the street the whole of the work has had to be carried out during week-ends and between the hours of 12 midnight and 7 a.m.

(To be concluded.)

New Zealand.—H.M. Trade Commissioner for New Zealand (Mr. G. H. F. Rolleston) reports that a firm of engineers at Christchurch desire to get into touch with British manufacturers of machine tools and to obtain the agency of British manufacturers of electric motors, cables and fittings in general. The name and address of the firm may be obtained at the C.I. Branch of the Board of Trade, 73, Basinghall Street, London, E.C. Any further communications regarding the inquiry should be addressed to H.M. Trade Commissioner, 9, Grey Street, Wellington, New Zealand.—*Board of Trade Journal.*

Patent Amendment.—The British Thomson-Houston Co., Ltd., are applying for leave to amend patent No. 13,276 of 1904 for "Improvements in protective devices for electric generating and distribution systems and apparatus." A notice relating to the matter appears among our advertisements to-day.

RECENT DEVELOPMENTS IN TEXTILE MILL DESIGN AND OPERATION: NOTABLY AS REGARDS ELECTRIFICATION.

By L. CROUCH.

The present notes deal with four groups of American textile mills, representing a total capacity of 17,000 kw., driving some 528,000 spindles and 19,400 looms. As these mills have only been in operation one or two years, and in some cases are still in course of installation, the following details* cannot fail to be of general interest to British textile and electrical engineers.

The Pacific Mills (Lawrence, Mass.).

These mills at present comprise a cotton department with 185,000 spindles and 6,717 looms, and a worsted department with 53,064 spindles and 2,650 looms, as well as a print works with 27 printing machines. Up to 1908 the mills were operated mainly by hydro-electric power, details of which are given later; in that year, however, the increasing demand for steam for manufacturing processes, and for power for the extended and faster running textile departments, led to the installation of a new steam-power station of 2,250 kw. capacity. The necessity for considerable further extensions was so far foreseen as to lead to the provision in the new steam station of 100 per cent. spare space for boilers and room for one more large turbo set, with all its auxiliaries, and the laying of the foundations for a second stack. The first section of the new station (three 750-kw. turbo sets and 12 boilers) was hardly completed when unexpected developments necessitated the installation of a 3,250-kw. turbo set and the building of the second stack.

Unfortunately, the new steam station could not be accommodated on the mill site, and, having to be located $\frac{1}{4}$ mile from the nearest pair of mills and $\frac{3}{4}$ mile from the lower mill yard, is thus in the position of an ordinary "central" station. There is no possibility of using the exhaust steam in the textile sheds, hence the whole problem becomes one of generating electrical energy as cheaply as possible, with no utilisation of waste products. Though the present power buildings are now full, there is ample room on the site to allow of future developments, so that the power supply will never have to be further sub-divided.

The old water wheels have been renewed (see later), there being no intention of abandoning the hydro-electric plant since a perpetual lease of the water-power (to an amount now fully utilised) was bought some years ago. New water wheels will be provided when required, the hydro-electric station running in parallel with the new plant. A certain amount of the steam plant installed in the old power houses will run till worn out, but will not be renewed, its load then being relegated to the new steam station.

The Steam Generating Station.—The new station is situated some 800 ft. from the Merrimack River, an ample cooling and feed water supply being thus ensured; rail facilities are also good.

Buildings.—The main buildings comprise a turbine house, boiler house and coal pocket, the chief dimensions and divisions of which are shown in figs. 1 and 2.† The buildings are of brick with steel framing, have reinforced stone concrete floors on steel beams, and reinforced cinder concrete roofs covered with plastic slate. The turbine foundations are separate from the floor, hence a minimum of vibration is transmitted to the buildings. The containing walls of the coal pocket are of reinforced concrete; the supporting columns and roof trusses of the building are of steel. The railway feeding the pocket is carried on steel bents within the latter and on wooden trestles outside the

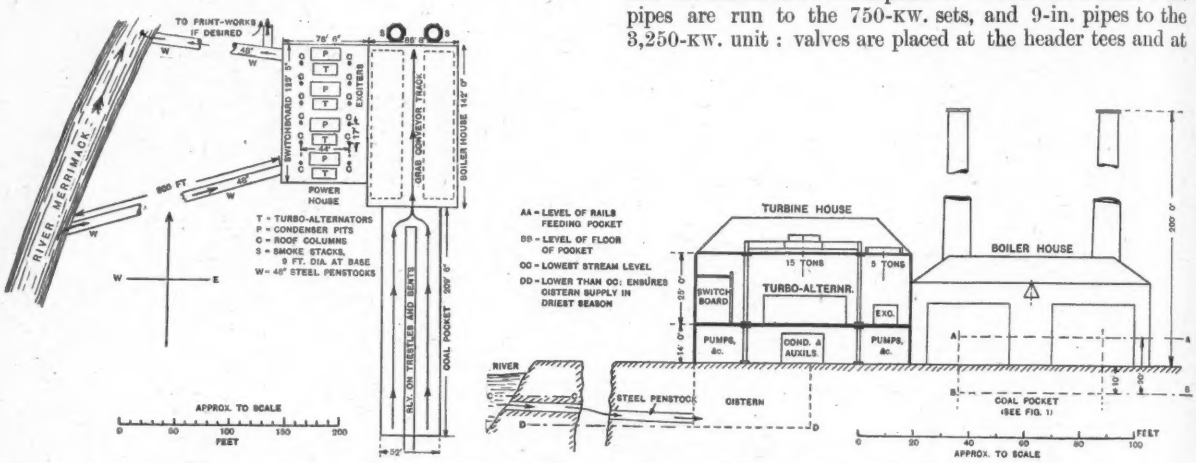
*Mainly extracted from a voluminous description of the same in *Electrical Age*, May, 1910.

† *Important Note.*—No drawings of the building arrangements are given in the original article (*loc. cit.*), but to explain simply what otherwise requires a long and complicated written description figs. 1 and 2 have been drawn by the writer. Similarly fig. 3 has been prepared from written data in the original description. The dimensions, divisions and scheme of operation indicated by these sketches are correct, but it is quite possible that the relative positions of the buildings are not as in the actual plant. This is, for the present purpose, quite immaterial.—L. C.

building. The roof is of wood covered with slates. The single-track conveyor (grab-bucket pattern) feeds the boiler house from the coal pocket, which butts on to it, as shown (fig. 1).

All the foundations are of concrete, and the nature of the ground was such as to necessitate piles for all the structures; 16-in. concrete piles were used, and found far superior to wooden piles in every respect.

Boilers.—Twenty-four horizontal return tubular boilers (Bigelow), each 72 in. diameter, and provided with 92—3½ in. × 20 ft. tubes, supply steam at 150 lb. per sq. in. : 125° F. superheat is given in Foster superheaters. The boilers are hung from I beams carried on columns, independently of the brick settings.



Figs. 1 and 2.—Turbo-Generator Plant, Pacific Mills, Lawrence, Mass.

Turbines, Engines, Alternators.—The main power plant consists of three 750-kw. and one 3,250-kw. Allis-Chalmers-Parsons turbo-alternator sets running at 1,800 r.p.m., and supplying three-phase current at 2,300 volts, 60 cycles. Each turbine is fitted with a centrifugal governor and automatic load and safety stop valves. The generators are of the revolving field, enclosed, forced ventilation pattern; cool, clean air is drawn from near the roof ventilators and forced through the rotating field arms. Forced lubrication is, of course, provided. Smaller generating sets are:—(1) A 75-kw. engine-driven alternator, used mainly for night lighting; (2) a 50-kw. steam-driven exciter; (3) one 55-kw. and one 100-kw. motor-driven exciter.

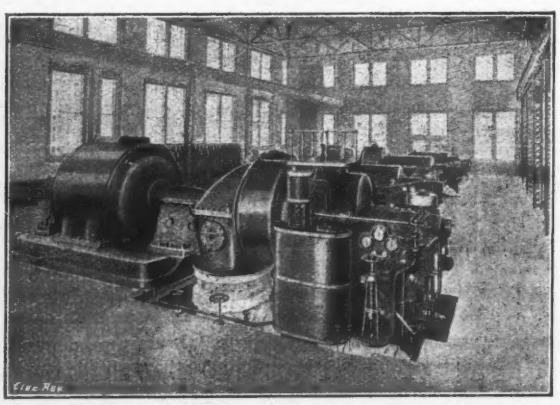


Fig. 3.—Pacific Mills Power House, showing 3,250-kw. set.

The main generators are designed for high overload capacity and for 80 per cent. power factor, this being the overall p.f. during the greater part of the day; when the lighting load comes on, the power factor is somewhat improved.

Auxiliary Steam Plant.—Condensers.—The 750-kw. units have single jet condensers, while to guard against breakdown, the 3,250-kw. unit has a double jet condenser, each jet being similar to, but larger, than those of the 750-kw. sets. All the condenser heads have adjustable spray cones, and each set is accessible to the large engine-room crane (see fig. 1). The path of the condensing water is shown in figs. 1 and 2.

Pumps.—Three 12 and 8 × 14 in. feed pumps and two 1,000-gall. underwriter fire pumps are provided.

A 3,000-h.p. closed feed-water heater completes the steam auxiliaries, all of which are in the turbine house basement.

Piping.—The steam piping is noticeable for the care which has been bestowed to ensure free expansion and maximum flexibility. Each superheater discharges through 4-in. nozzles and suitable valves into a 10-in. steel header supported by balanced levers hung from the roof. One vertical and one horizontal bend between each superheater and the header allow for expansion. From the header 6-in. pipes are run to the 750-kw. sets, and 9-in. pipes to the 3,250-kw. unit: valves are placed at the header tees and at the turbine steam chests. Two pipes are run from the header to feed the various auxiliaries.

The feed water can be taken at will from the river-fed cistern (see figs. 1 and 2), from the city mains, or, as normally, from the hot condenser discharge. The water, wherever obtained, is pumped through the feed heater into a 7-in. brass main in front of the boilers whence the feed is taken. An auxiliary cold water iron feed main is provided in the boiler house for test or emergency purposes.

Steam Station Switchboard.—The 15 panels of this board are thus allotted: 3 panels controlling the d.c. exciters, 2 panels for the exciter motors control, 5 panels controlling the alternators, 1 total load panel and 4 feeder panels.

The alternator panels are fitted with one ammeter, voltmeter, indicating wattmeter, recording wattmeter and one three-pole single-throw non-automatic hand-operated oil switch. The total load panel contains a polyphase indicating wattmeter, Chapman voltage regulator, p.f. meter, and three-phase ground detector. The feeder panels have each an automatic hand-operated remote control, three-pole single-throw oil switch, and one wattmeter per feeder circuit. The synchroscope and station voltmeters are bracket-hung as usual.

All oil switches are on the wall at the back of the board, the operating levers passing under the floor. Rheostats are placed in the basement, and the machine and feeder leads are run along the basement ceiling.

Hydro-Electric Station.—The original power plant of the mills, now operating in conjunction with the new steam station, consisted of two sets of water wheels at the upper mill (see fig. 4, and note to figs. 1 and 2), and one set at the lower mill. The two sets of old wheels at the upper mill were successively renewed in the spring of 1909 after the inauguration of the first section of the new steam plant (1908; 3,250-kw. unit added, summer 1909) by relieving each in turn by the aid of the new plant.

Electrical drive from the renovated hydraulic plant was decided upon for several reasons:—

1. Electric drive had of necessity been adopted from the new steam plant, owing to this having to be ¼-¾ mile away from the various mills (fig. 4).

2. Electrical driving from the new hydraulic station would therefore come into line with the rest of the equipment and

enable *parallel operation of the hydraulic and steam stations*, which in turn :—

(*a*) Simplified the renewals of the wheels as above.

(*b*) Obviated the necessity for spare steam plant at the hydro-stations by enabling extra power to be drawn from the steam station during times of flood. Hitherto, with mechanical drive, spare steam plant had been provided as the only alternative to complete shut down during times of flood when the backwater became too high.

3. The upper mill hydro-electric plant now enables the new steam station to be shut down during the night when the load is very light. This effects a considerable saving, the water power (apart from operating charges) costing no more when utilised than when going to waste.

4. It was found that electrical driving *secured the benefit of more complete flexibility of operation.*

Of the two sets of wheels at the upper mill, that at the "East Pit" drives an 800-KW. generator, that at "West Pit" a 600-KW. unit; both alternators are built for three-phase, 60 ~, 180 R.P.M., and 600 volts terminal pressure. They are connected to the bus-bars on the low-tension side of the 1,000 K.V.A. transformers referred to below. Both generators are controlled from West Pit, the governors of both sets of wheels being electrically controlled from the West Pit switchboard, on which is also an indicator showing the gate opening of the East Pit plant at any moment.

Each set of wheels consists of one pair of 39-in. and one pair of 36-in., type C Hercules wheels (Holyoke Machine Co.). The wheels run in steel cases with steel-draught tubes, and owing to the limited depth of water beneath the latter, conical diffusers are used below each. The normal head of 28 ft. is so much reduced in times of flood that, whereas the two 39-in. wheels normally use the full volume of water rented, the two 36-in. wheels have also to be used when the back

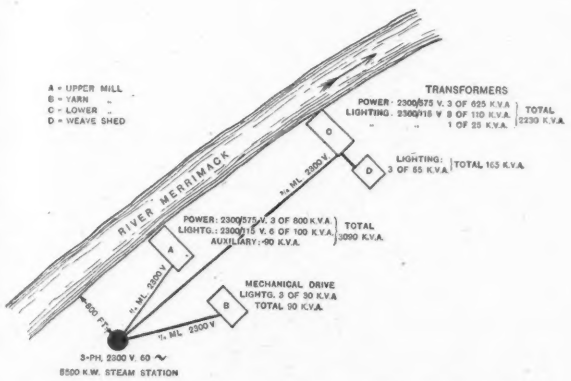

A = UPPER MILL
B = YARN "
C = LOWER "
D = WEAVE SHED
TRANSFORMERS
POWER: 2300/575 V. 3 OF 625 K.V.A.
LIGHTING: 2300/115 V. 2 OF 110 K.V.A.
1 OF 25 K.V.A.
TOTAL 2230 K.V.A.
LIGHTING: 3 OF 55 K.V.A.
TOTAL 165 K.V.A.
RIVER MERRIMACK
¼ ML. 2300 V.
POWER: 2300/575 V. 3 OF 800 K.V.A.
LIGHTG.: 2300/115 V. 6 OF 100 K.V.A.
AUXILIARY: 90 K.V.A.
TOTAL 3090 K.V.A.
MECHANICAL DRIVE
LIGHTG. 3 OF 30 K.V.A.
TOTAL 90 K.V.A.
¼ ML. 2300 V.
¼ ML. 2300 V.
800 FT.
3-PH, 2300 V. 60 ~
8500 K.W. STEAM STATION

FIG. 4.—SHOWING APPROXIMATE POSITIONS OF THE MILLS.

water is high. The smaller wheels run better under the lower head, and maintain the efficiency of the plant. Speed changes of not more than 5 per cent. are normally allowed by the governors.

Switchboards.—The switchboard in the hydro-electric station is smaller than, but similar to, the steam station board, except that the oil switches are here automatic with time relays. The various mill switchboards (see later notes on Distributing System) are connected to the low-tension side of the various transformers (fig. 4), and supply the motors and lights through open wiring, usually run along the ceiling.

Transmission Cables.—Distribution System.—Each mill yard is supplied by one feeder circuit from the new steam station. There is thus a distributing centre in each mill yard, and any local generators (as at the Upper and Lower Mills) can be readily placed in parallel with the main supply.

Underground transmission has been adopted for the various feeders, incidentally avoiding lightning troubles (more serious in America than in England); the main reason for the selection of this system seems, however, to be the possibility of a city ordinance against high-tension overhead lines. The voltage, lengths and general arrangements of the cable and transformer systems are shown in fig. 4 (see note to figs. 1 and 2). One circuit consists of four 4-0 cables, another consists of three 3-0 cables, and the third has two 3-0 cables.

The cables are three-conductor, stranded copper, varnished cambric, lead-covered, insulated for 5,000 volts and laid in vitrified tile ducts with manholes at 300-400 ft. centres. Where the cables pass under a railway and public road a concrete tunnel has been built to save future dislocation and expense when extra lines become necessary.

All transformers are single-phase, and, if of more than 100 K.V.A. capacity, are water-cooled; besides the transformers indicated in fig. 4, there are, at the Upper Mill, three auxiliary power and three auxiliary lighting transformers (each 15 K.V.A.).

The feeders supplying each of the main departments of the various mills have each a graphic integrating meter. Power measurements are thus easily made, and appropriate charges allotted to the various departments.

Motors.—The total horse-power of the motors installed is 6,300 H.P., the mean capacity being 45 H.P. each (140 motors). All these machines are of the A.C. induction type, having squirrel-cage rotors for outputs of less than 50 H.P. and wound rotors if of higher horse-power. Group driving is universal except in the picking rooms at the upper mills. The motors are mainly hung on the ceilings, but some few are located on the floors (as in the case of the loom motors); some, again, are fixed on wall brackets. Each group motor has its own ammeter and automatic oil switch with overload and no voltage release.

Lighting.—The lighting load is carried entirely by the steam station except on occasions when the upper mill hydraulic plant is taking the whole night load. The mill yards are large, so that copper saving, aided by the adoption of three-phase four-wire connection of the transformer secondaries, becomes an important matter.

Incandescent lamps and arc lamps are mainly used for lighting, but in one weaving shed, requiring all-day lighting, mercury lamps are employed. An auxiliary lighting circuit includes a small number of lights in each mill room for dim "out-of-hours" lighting and such of the yard lamps as are lighted all night. This auxiliary lighting may be handled by the main steam station generators or by the 75-KW. engine-driven unit already noted.

(*To be concluded.*)

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Combined Destructor and Electricity Works.

May I be permitted to add some little information on this subject—some practical information?

Your contributor in your issue of Dec. 9th, says, "when it was first proposed to utilise the heat from refuse destructors to raise steam for electricity works . . . a crop of exaggerated statements resulted." Judging by his article, statements about refuse destructors are no less exaggerated to-day.

Of course, destruction by fire is the most sanitary way of dealing with refuse, but the statement that the average calorific value of refuse is about one-seventh that of good bituminous coal will not bear examination.

It should not take more than 5 lb. of coal to generate a unit of electricity, which is equal to 448 units to a ton of coal. An average of the destructor plants in this country does not give more than 33 units to a ton of refuse—I am ignoring test figures, which prove nothing, and are, in any case, not believed—showing refuse to be equal to one-fourteenth of good bituminous coal.

To attribute the low fuel costs of some towns which have combined destructor and electricity works to this fact is to assume a condition of affairs which does not exist. Up to a very recent date I was managing (indeed, I designed and set to work) the combined destructor and electricity works at Burslem, Staffordshire. The fuel costs (·25d. per unit) are the lowest in the country for a station with an output of

under 1 million units; but it is absurd to attribute these low costs to the fact that the works are combined. At the same time it must be admitted that in the early days of an electricity supply undertaking the combination of the destructor with an electricity works is a very great assistance.

As the electricity works develops, and the output increases with a better load factor, it is far more economical to generate steam from coal-fired boilers alone than to work the plant in conjunction with the destructor. This has been proved times without number at the Burslem works.

Assume for a moment that "the amount of refuse per 1,000 inhabitants is about 20 cwt. per day," and that 50 units is an average figure per ton "which any moderately well-managed combined plant might attain to," though this, in fact, is most certainly not the case. I very much doubt if the figure (33) which I have assumed (and which I know from actual experience is obtained at Burslem) can be obtained in an average of plant. But assuming these figures, then at Partick, with a population of 70,000, which would be equal to 70 tons of refuse per day for, say, 300 days, it would appear that 1,050,000 units were supplied by the refuse out of a total of 1,976,911 units sold last year. Or take St. Helens, with a population of 95,000 inhabitants—95 tons of refuse a day for 300 days would give 1,425,000 units supplied by refuse out of a total of 2,484,631 units sold last year. That is, at Partick 53 per cent. and at St. Helens 57 per cent. of the output is apparently being carried by the refuse destructor. Of course, nothing of the sort is being done—so now what about "exaggerated statements"?

I should like to follow your contributor through the "summary of data":—

Site.—I agree that the site should be considered principally from the point of view of collection and delivery of refuse, but the cartage of clinker must not be lost sight of. I know of destructors, on the side of a canal, from which the clinker is barged away—a most expensive and unnecessary proceeding, and one easily avoided had a really suitable site been determined upon.

Quality of Refuse.—If the best refuse comes from the poorer districts and the factory towns, the worst and poorest refuse comes from seaside towns, at which towns a refuse destructor is an absolute necessity.

Notwithstanding this fact, how often are the electricity works and destructors at such towns combined, and prove to be failures!

Charging.—The destructors from which are obtained the best results for combined working are those which are of the hand-fired front-feed type.

Dust.—A clear emission from the chimney does not mean there is no dust—dust cannot be avoided at a destructor works.

Forced Draught.—Steam jets, used for forced draught, are most uneconomical, and waste (after a few months) half the steam the boiler generates. Every engineer knows how very uneconomical small steam engines are. The most economical method to employ is a motor-driven fan, the speed of which can easily be varied to suit the load.

Thermal Storage.—Thermal storage is in any case an extravagance, but it is absolutely useless where it is possible to utilise all the steam the destructor generates.

Clinker.—Making clinker into anything (slabs, bricks, curbs, &c.) is not an economical proposition, although such a course does find employment for the unemployed.

Management.—A combined station, to be a success, must be under the management of the electrical engineer, but only so far as the steam-raising is concerned. He should not have anything to do with the carters further than to see that the bunkers are kept sufficiently supplied with refuse for the purpose of steam-raising.

Stokers.—The one great improvement to be made with destructors is in the charging of the cells. At present, to be really satisfactory and efficient, this has to be done by hand, the men being in contact with the refuse. Anyone who has had practical experience of the work knows how really disagreeable it is. Means to efficiently charge the cells by mechanical methods will ultimately be devised. Then, for more easily clinkering, the cells should be built as inclined retorts; and overhead travellers should be used so that the men do not have to wheel red-hot clinker, with the dust and fumes blowing into face and lungs.

Combined destructor and electricity works have their uses; but nothing is to be gained by "exaggerated statements" concerning them. Too much is made of the combination being a great commercial success. It is quite impossible to rely upon the steam from a destructor—as any steam chart taken off the destructor steam range will show. (I do not mean "taking-over test" charts, which are of no value at all.) But one cannot generate steam from garbage and offal continuously, therefore at least one extra coal-fired boiler must be kept banked up—if, indeed, not under full steam—ready to carry the load over the "dips" caused by the intermittent steam from the destructor.

Ashton Bremner.

Wolstanton, Stoke-on-Trent.
December 13th, 1910.

Commercial Training of the Engineer.

As one whose lot it has been to supervise some important estimating departments, I have read with much interest Mr. Kilburn Scott's letter in your issue of December 9th, under the above heading.

I can quite endorse Mr. Scott's statements regarding the number of young engineers one finds with good technical training, who, meeting for the first time the commercial side of electrical engineering, feel it irksome, if not positively distasteful, to them.

That this is sometimes due to purely scientific taste and methods of thought there can be little doubt, but I venture to suggest that it is more often due to the fact that many sound financial principles underlying electrical engineering work, apart from speculative practice, have not presented themselves in such a light as should attract from really scientific interest in the first instance. It is here, I think, that educational institutions can do much towards the turning out of technical-commercial engineers.

There is one feature, however, peculiar to this vale of tears (earth) to which Mr. Scott only briefly alludes in the concluding paragraph of his letter. This, for want of a more correct term, I may refer to as the "human element"; it enters very largely into all commercial transactions. For instance, the policy of assurance companies in basing their rates upon "average" mortality tables may be said at once to be as eminently scientific as it is commercially sound, but by retaining the power to "select" their clients, those companies have duly recognised and provided for the human element. The point naturally arises, how far can this human element be dealt with by educational institutions? One feels instinctively that young engineers starting in business for themselves should be warned of many things appertaining to what is somewhat mildly termed "sharp practice." Yet there is probably no educational institution in this country but would rather put the subject on its syllabus under another name.

Mr. Scott may be interested to learn that at the Battersea Polytechnic, also, special attention is being given to the commercial side of electrical engineering.

William Brew.

London, *December 12th*, 1910.

Annual Supper.—An annual supper of the employés of Messrs. T. W. Vaughan & Co. took place at the Old Thatched House, Islington, last Saturday evening. The firm has lately taken a 21 years' lease of the commodious premises, 22, Cross Street, Islington, lately vacated by the Library Bureau Co. Mr. T. W. Vaughan, one of the partners, presided. In the unavoidable absence of Mr. W. G. Smail, the other partner in the firm, the vice-chair was taken by the leading foreman of the art metal department, Mr. T. Tappenden, who has been with Mr. Vaughan many years. The whole of the staff were present.

New Aluminium Works.—It is reported from Vienna that a financial group, headed by the Anglo-Austrian Bank and the firm of Adolf Kohner & Sons, proposes to erect a works for the production of aluminium in Transylvania. The preliminary labours are said to have reached such an advanced stage that a limited company will be formed for the purpose at the beginning of next year.

OUR LEGAL QUERY COLUMN.

[Questions addressed to this column should be written on one side of the paper only.]

"Anxious" asks:—"Is it possible to run a private telephone wire from housetop to housetop across a public street in the suburbs? Has the Postmaster-General any jurisdiction in such a case? and is the statement which has been made to me correct, that the Urban District Council (although having in the ordinary way no rights regarding telephones) is fully empowered to remove any such private telephone wire across a public street?

*** Our correspondent is apparently aware of the fact that the Postmaster-General has a monopoly of the telegraph service; but upon the facts stated, it seems that the installation which it is proposed to put up is outside the monopoly. Thus Sec. 5 of the Telegraph Act, 1869, excepts from the exclusive privileges of the Postmaster-General, which are conferred by Sec. 4, "telegrams (which term includes telephone messages) in respect of the transmission of which no charge is made, transmitted by a telegraph maintained or used solely for private use, and relating to the business or private affairs of the owner thereof." It is most probable that the installation which our correspondent proposes to put up is within this exception, but it is difficult to speak positively without knowledge of all the facts. As to the right to suspend wires over the street, it is clear that the Postmaster-General has no control over this matter. But it is true that a local authority has power to prevent overhead wires in certain cases. Thus, if such wires were in such a position as to interfere with the street traffic, the local authority might certainly cause them to be taken down. Apart from their interfering with the local traffic, however, the local authority have no jurisdiction over them.

LEGAL.

Griffiths and Another *v.* Benn.

This action again came before the Court on Friday last, when an application was made to Mr. Justice Ridley sitting in the King's Bench Division. It will be remembered that the jury awarded the plaintiffs £12,000 as damages, and granted leave to appeal, subject to £5,000 being brought into Court by the defendant as security.

Mr. Eames, appearing on behalf of the plaintiffs, now informed the Court that Sir John Benn had failed to pay into Court the £5,000 within 10 days, and he therefore asked his Lordship to say that the stay of execution should now be removed. At the time the application was made by Sir Edward Clarke on the defendant's behalf, Sir John Benn said he would have no difficulty in finding the money, nevertheless the conditions had not been complied with within the prescribed time. He (counsel) thought personally that the stay of execution would automatically be removed after 10 days had elapsed, but his clients desired to issue a bankruptcy notice, and the officials concerned saw some difficulty because of the question whether the stay really did exist or not. Counsel added that Sir John Benn's solicitors had informed his clients that Sir John did not intend to find security, and he had an affidavit to that effect.

Mr. McCardie, for the defendant, said he would ask his Lordship, instead of granting Mr. Eames's application, to say that the stay of execution should continue without any security. If it were an ordinary action he would not for a moment make such an application, but he thought everyone would agree that the case presented not only very serious questions of fact but many somewhat complicated points of law. The amount of damages, too, was extremely large. The appeal must be heard soon after the beginning of the next sitting, and all he asked his Lordship to do was, in view of the magnitude of the case and the important questions involved, to say that there should be a stay of execution until the hearing of the appeal without any security being given. His learned friend had referred to a bankruptcy notice which his clients desired to issue, but nobody could doubt, looking at the whole matter, that to prevent the appeal from taking its course was rather oppressive.

Mr. Eames said the application of his learned friend was unheard of. It was found by the jury, after a hearing lasting 14 days, that Sir John Benn had made misstatement of facts, and they also found that he had made them maliciously. His own counsel asked for a stay of execution and offered security.

Mr. Justice Ridley: I forget who suggested it, but it was agreed to, certainly.

Mr. Eames: Sir John Benn said he would be willing to give security for any reasonable amount that your Lordship should fix, and your Lordship suggested £5,000. He accepted that at once. Therefore it is not open for him to ask that this condition be rescinded, even though it were a usual application to make. My learned friend has suggested that our action in issuing a bankruptcy notice is oppressive. I can only say that the action of his client in ruining my clients' business was oppressive enough, and was sufficiently spoken to by the jury. If his application is allowed, we shall have to bear the expense of a big appeal without a penny of security.

His Lordship said he could not agree to Mr. McCardie's suggestion. As the plaintiff could not find security for costs, the stay would be removed.

Elliott *v.* Battersea Borough Council.

In the King's Bench Division on Thursday, December 15th, Mr. Justice Grantham and a special jury, concluded the hearing of an action by Mrs. Louisa Elizabeth Elliott, of Battersea, for damages for personal injuries sustained owing to an explosion and fire in an electric light section or street box belonging to the Battersea Borough Council at the junction of Battersea Park Road and Latchmere Road. The Borough Council, who were defendants to the action, denied that the accident was due to any negligence on the part of their servants.

Mr. Lewis Thomas, K.C., for the plaintiff, said that while out shopping one evening in October last, the plaintiff stopped at the corner of Battersea Park Road and Latchmere Road to wait for a tram. While there an explosion and fire occurred in the street-box or pillar by which plaintiff was standing. Mrs. Elliott was in consequence thrown violently to the ground, and the consequences to her health had been serious. Counsel argued that the accident might have been avoided by proper care on the part of the defendants' servants.

Evidence was called to support counsel's statement.

Mr. Hugo Young, K.C., for the defendant Council, said there was no dispute about the occurrence of the explosion which caused the accident. The only question was whether the local Council were responsible. Pillars such as the one in question were used for the purpose of acting as distributors. In this case three cables from the power stations were led to the pillar. Two of them simply passed through the pillar, but the third was split up into a distributing main to serve some 37 wires. The wires were fed with current from the cable, and for greater safety a fuse was affixed to the distributing main as it left the pillar. The cable itself was properly insulated, and laid in a trough filled with liquid bitumen and covered with tiles to keep out damp. It was properly laid. Defendants' case was that but for the act of a third party there would have been no danger. There was over the Borough Council's trough at this place a point-box to carry switches to work the tramway points: and after the accident it was found that one of the tiles over the defendants' trough was starred and split as if some instrument had been driven through it. In that way, no doubt, the moisture had got to the cable which caused all the trouble; but that was not the fault of the Borough Council.

Mr. Frederick Arthur Bond, electrical engineer to the Battersea Borough Council, said he superintended the erection of the pillar in question. So far as he could see every appliance was arranged to ensure safety.

Mr. J. F. C. Snell said that the installation at Battersea was as perfect as it could be made. It was impossible for the accident to have happened but for the intervention of a third party.

In the end, the jury returned a verdict for the plaintiff for £525, and judgment was entered accordingly, his Lordship refusing to grant a stay of execution.

Improved Electric Traction, Ltd., *v.* Chloride Electric Storage Co.

Mr. Justice Channell, sitting in the King's Bench Division on December 14th and 15th, heard this action, in which the plaintiffs sought to recover money paid under an agreement, and damages in respect of an alleged breach of the agreement, dated August 30th, 1907.

The plaintiffs claimed that the defendants had detained two electric batteries of the value of £68. The defendants were to provide two electric batteries of electric accumulators to draw vehicles of two tons and one ton respectively, the defendants agreeing to maintain the batteries till the vehicles had covered 4,000 miles in a series of runs. The plaintiffs were to pay three halfpence a mile for the 2-ton vehicles and a penny a mile for the other, with the option of renewing the agreement on terms. About October, 1909, the defendants removed the batteries for repairs and refused to return them. The plaintiffs said that they were thereby deprived of the option of purchasing, but defendants said that the batteries were at all times their property, and that the plaintiffs, in breach of the agreement, had failed to provide, fixed to the vehicles, a mileage indicator which clearly indicated the distance travelled, and that by reason of the breach the defendants were within their right in removing the property. They also counterclaimed.

During the two days' hearing a number of scientific witnesses were called on either side, who gave technical evidence as to the working of the batteries and in the manner in which the terms of the agreement had been carried out.

Mr. Justice Channell, in giving judgment, said that the case raised many technical questions in relation to electricity, of which he was sorry to say he had no knowledge. It seemed to him that under the contract the plaintiffs were to do some things and to use the batteries fairly and properly. They were not the skilled people in the matter, and the defendants were. The defendants were to maintain the batteries, and it would be necessary for them, in order to do so, that they should from time to time have the opportunity of inspecting them. It seemed to him that it was the defendants business to instruct the plaintiffs as to what they ought to do. It was extremely probable that the batteries were neglected by the plaintiffs, and the reason of that was that they did not have the amount of use for the vehicles which was contemplated. It seemed that whenever they found anything like neglect it was almost always found that the vehicles had obviously not been used much at the time. The neglect was not taking care of the things when out of use, and it could be seen that that would have some effect

upon them. It was complained of by Mr. McPherson in his report, but things were put right in 1908, and it was said that the next three or four reports were entirely satisfactory, showing that the plaintiffs were taking care of the batteries, and that they were working all right. It was a considerable time before he reported again, and on August 7th he reported that one of the batteries was in a condition which would necessitate the expenditure by the defendants of a considerable sum of money upon it under their contracts. He said that it had not been used since the last time he reported. He (the judge) thought that the plaintiffs did not take the care of the vehicles, when not running, that they ought to have done. The consequence of that was that the defendants seemed to have conceived the idea that it would be better for them to take possession of the batteries again. They wrote to the plaintiffs and got an answer which seemed reasonable, saying that the gentleman who knew most about the matter was away, but that if there had been any neglect it would be treated in a proper way. Instructions were given to Mr. McPherson to investigate, and he reported at different times as to what he had done before, and shortly afterwards he was told to get the things away, and tell the people that they were going to be repaired, and that they would be back in a few days, mentioning the seven days as stipulated in the contract, but in a letter he wrote that he did not think the batteries would see Westminster again. He undoubtedly knew that it was the intention to keep them; but they had no right to do that. He (the judge) thought there was no violation of the agreement, although it was possible that the plaintiffs might to some extent have neglected the batteries when not in use. Compensation might have been asked for that. The plaintiffs had really not lost much. They were not using the vehicles except for the purpose of trying to get orders for other vehicles. He did not think they were entitled to substantial damages for that; but they were entitled to something for not having got the amount of running which they paid for. He would give them £14 15s., but not any other damages for the loss of the vehicles. That £14 15s. was damages for the batteries having been taken away; but then there was the plaintiffs' right to purchase, and his judgment would be for the plaintiffs for £96, with costs.

Judgment was entered accordingly.

Newcastle-on-Tyne Electric Supply Co. *v.* Mayor and Corporation of Newcastle-on-Tyne.

In the Chancery Division on Friday and Saturday, December 16th and 17th, Mr. Justice Swinfen Eady heard this action.

The plaintiffs asked for a declaration that after August 6th, 1910, the defendants were bound to take from the plaintiffs all electrical energy reasonably required by them for working or lighting the cars upon such of the tramways as now were, or might be, constructed in the district which was formerly the urban district of Walker, at a price to be fixed, failing agreement by arbitration; and that the defendants were not entitled themselves to supply electrical energy for the purpose. An injunction was also claimed to restrain the defendants from supplying any electrical energy required after August 6th, 1910, for working or lighting the cars upon any of those tramways.

Mr. Frank Russell, K.C., with Mr. Arthur B. Shaw were counsel for the plaintiffs, and Mr. Freeman, K.C., Mr. Macnaughten, K.C., and Mr. Sargent appeared for the defence.

Mr. Russell, in opening the case, said the plaintiffs were one of the largest companies in the kingdom for supplying electric light and energy. The plaintiffs claimed that after a certain date defendants were bound to take from them all the electrical energy for working or lighting the cars of the defendants' tramways in the urban district of Walker at arbitration prices, and an injunction following on that declaration. The rights of the parties depended entirely upon the construction of various Acts of Parliament, provisional orders and agreements, and there was no question of any fact upon which it would be necessary to hear evidence. The real question was whether the result of the various documents was, as plaintiffs' contended, to give them the right to supply, after a certain period had expired, viz., 10 years, and that the Corporation were under an obligation not to supply themselves at the expiry of that period. The plaintiffs wrote to the defendant Corporation claiming the right of supply, but defendants repudiated the claim, and the action now before his Lordship was to prove who was right. The result of the documents, counsel continued, was to vest in the plaintiffs the rights of the Walker Council, and once the period of 10 years had expired, the plaintiffs had the right to supply and not the Corporation of Newcastle, under whose jurisdiction the Walker district had since come.

Mr. Freeman, K.C., for the defendants, said the question was one entirely of construction. His contention was that on the documents the Corporation at the end of 10 years had the right to supply their own tramways and tramway cars and sheds with electricity from the Corporation's generating station. The point involved was really a very short one, although very important. The beginning of the whole thing was that the Walker Council had certain powers conferred upon them with regard to electricity within their district. That Council had not cared to act on those powers themselves, and had delegated them to the Newcastle Co. for a certain period. It was competent for the Walker Council to lay lines and transmit electricity for the purpose of the tramways, but they were not given a free hand with regard to Walker itself. The Newcastle Corporation had the same powers as were given to the Walker Council before the latter district became part of Newcastle.

His Lordship: The Corporation of Newcastle succeed to the position the Walker Council held?

Mr. Freeman said that the Walker Council had power to make arrangements with the Newcastle Corporation, and he submitted that the Walker Council had power to supply electricity from their own generating station, and that power they had passed on to the Newcastle Corporation when the Walker district became part of Newcastle.

Mr. Macnaughten, K.C., said that until 1910 defendants had to take the electricity in Walker from the plaintiff company, but after that date they could, with the consent of Walker, supply themselves. He submitted that the proviso which said that his clients might "transmit and use" electrical energy was equivalent to saying that they might supply electrical energy. If it did not mean that it meant nothing.

His Lordship did not think that counsel's argument was consistent with the language of the proviso. To "transmit" meant one thing, to "use" another, and to "supply" meant something else.

Mr. Macnaughten said they must make the best of the interpretation, but he did contend that if the proviso did not bear the meaning he submitted it did, then it was perfectly illusory. The only reasonable interpretation was that it left in Walker and did not transfer to the company the powers preserved to Walker by an agreement of 1903.

Mr. Russell, K.C., in reply, submitted that the plaintiffs had established their rights and were entitled to the declaration they asked for.

His Lordship, giving judgment, said that the short point which had arisen for his decision was whether the defendants were under a contract to take from the plaintiffs the electric current required for working and lighting the tramways in Walker. The Walker Urban District Council obtained a provisional order giving them powers to supply electricity, and by an agreement of July, 1900, made between the Walker Council and the plaintiff company, it was agreed that the plaintiffs, for a term of 10 years, commencing from August 6th, 1900, should take upon themselves the responsibility, obligations, and liabilities, of the supply of electrical energy within the Council's district under the Walker Electric Lighting Order. By their defence, defendants said that they were now the Walker Council, and they agreed and consented that the Corporation should supply electrical energy. If the Walker Council could not consent, said his Lordship—as clearly they could not—then the defendants, as the Walker Council's successors, could not consent either. It was contended that the words "transmission and user" were equivalent to "supply," but he was of opinion that clearly those words had no reference to supply. The words "supply," "transmission" and "user" were all well known, and were frequently used in connection with agreements relating to electrical energy, and "supply" was a wholly different thing from "transmission" and "user." The construction of the agreement was clear, and the Corporation were bound to take the supply of electrical energy from the plaintiff company. The result was that there would be a declaration to that effect. There would, however, be a suspension of the injunction for a reasonable time, he would say till over January 13th next to enable the necessary connections of the supply cables, &c., to be made. If that time were found to be insufficient, then he would give leave for an application for extension of time to be made.

The Marconi Patent Case.

(*Continued from page* 981.)

Mr. Jas. Swinburne, examined by Mr. A. J. Walter, explained the properties of a Leyden jar, and the investigations of Henry and others with reference to the discharges from such jars. He next referred to Hertz's investigations and discoveries as to waves, and made drawings to show the nature of the propagation through ether of a Hertz wave. He said that the oscillatory discharge from a Leyden jar only took place when the spark was passing. As regarded transmitting a series of signals without wires, there was nothing which had been done practically before Marconi's 1896 patent, although people had ideas about it which were not worked out. Dealing with Lodge's 1897 specification, he said that Lodge used capacity aerials and then inserted induction coils. A straight aerial was simply a straight wire, and was insulated. Lodge took a straight aerial and put in an induction coil, which added to the inductance without adding to the radiating power. The result of inserting an induction coil in a straight aerial, was that one got more persistent energy than one would in a straight wire. It was a very great advantage so far as syntony was concerned, but would affect radiation. That was to say, that in so far as he had increased the induction, and increased capacity, and increased the radiation in part, the radiation as a whole was decreased, because of the lower frequency. In all his aerials he had an induction coil, and that would reduce the number of radiations per second. In that sense it was a compromise between a good radiator and a good oscillator. He was making a worse radiator. Coming to the Marconi patent in question, witness said that there were two currents of high frequency. Tuning between the primary and secondary was a matter of importance. By throwing the oscillating primary over to the radiating secondary, the distance of the wave was increased.

Speaking generally, what effect would that have on the advancement of science?—In degree it was enormous, because of the commercial value of the increased distance. Regarding the advantages this particular apparatus had in increasing selectivity, capacity inductors and spark gaps were essentials of an oscillating circuit, and as brought together in the "four sevens" patent, made an enormous advancement in wireless telegraphy.

Is it a fact that it is having the two circuits in tune that has

enabled this great advance to take place?—Yes, it has enabled one to send out a powerful message to a great distance. Continuing, WITNESS said that, generally speaking, there was no difference between the defendants' apparatus, and that of Mr. Marconi. It was only a matter of degree.

WITNESS was referred by Mr. Walter to a diagram, for the purpose of showing the flow of electricity by analogy to the flow of water. The analogy, he said, was quite close. He had considered all the earlier specifications that were relied upon as anticipations, and he found nothing that, in his opinion, described in any way the plaintiffs' invention.

It has been said that the plaintiffs' invention was not useful?—It is undoubtedly useful.

It has been further suggested that it contains no subject matter?—I don't think so; I think there is no end of subject matter in it.

MR. TERRELL, commencing to cross-examine, said that he desired to put some questions in very simple language, and commenced by experimenting with some steel filings and a magnet. The lines thus formed, said witness, showed the lines of force.

Certain flashes were visible, and counsel asked, "What are they doing?"—The conductor of the experiments said they were forming rings round the wire.

Now reverse your current, which is the same thing as alternating it. What we have been doing is with a continuous current.—WITNESS said the filings remained where they were, but their magnetic action was reversed. With a continuous current the field was round the wire and at right angles to it. When the current was broken or sent round the other way, the magnetic field was still there, but in a reversed direction. If you got two transformers with an equal number of turns in the primary and secondary and sent a current through the primary, you got exactly the same current in the secondary. It was only at the moment of oscillation that the transformer acted, and therefore it did not act in any way on a direct current. Tesla was the first to talk about the waves they were concerned with in this case.

And Tesla's waves more nearly conformed to the length of wave used at the present time than did the waves of Hertz?—WITNESS said he was not sure, but should think so. Taking the circuit as described by Tesla, which was a continuous one, he could not say that any engineer in 1900, the date of the patent sued upon, would have known how to get the tap, tap, tapping necessary for a wireless apparatus. A wireless specialist might have done so, but he was not sure. Assuming that a receiving station was in tune, it would receive the energy if it was rammed through instead of by the tapping mode, but it would not have been a good way, because you would get rid of the energy too quickly. With regard to the specification of the defendants, there was both self-induction and mutual induction in their apparatus—mutual induction, because there was a magnet.

With regard to a transformer, it is sometimes used for increasing or decreasing voltage?—Yes.

After the usual luncheon adjournment, two experiments were conducted, showing the effect of a current on iron filings. To show the magnetic field of a coil, iron filings were strewed over a card with the coil embedded half way through. In order to show how far Tesla had progressed, the apparatus fitted up in Court was used. A spark of about 12 in. in length was produced, which ran round a Leyden jar, and on a glass bulb being inserted into the spark very rapid changes occurred in the electric pressure, inducing electrical displacement in the globe to break down the insulation of the air.

MR. TERRELL put it to witness that these were Hertzian waves?—Yes.

And of the same length as used in wireless telegraphy?—Yes.

MR. TERRELL referred at considerable length to lectures by Tesla, part of which witness described as nonsense. Tesla's language, he said, was vague, but he was a very able man all the same.

Don't you think that he knew what resonance meant?—He might.

Is your complaint that Tesla is not clear enough?—It is.

But you think he knew what resonance was?—Yes, I think he did. Continuing, he said that in 1900 they would not think that it meant tuning. In a particular case, the breakdown of a cable, it was known that it was due to resonance. Tesla evidently looked upon resonance as a fearful beast that brought about the breakdown.

But he knew what he was wanting, and how to get it?—Yes, in this particular case.

You say that Tesla did tuning for the same purpose as Marconi?—Yes.

And in the same way?—No, not in the same way.

You do not attribute to Sir Oliver Lodge the same defect you attribute to Tesla?—No.

Sir Oliver Lodge was a deep thinker?—Yes, he was a great man. Witness did not think Sir Oliver Lodge knew resonance in the electrical sense. What Sir Oliver was endeavouring to do was to apply syntony to wireless telegraphy. If it was well known there would have been no need for Sir Oliver Lodge to apply himself to the matter. Witness knew Sir Oliver had a system installed at Elmers End. He had heard that it had a very large field—about 400 miles. He believed it was chiefly used for battleships. He thought it very possible that one might get into communication with it from that Court. He had not seen the station, though he knew Elmers End.

On December 15th, before the cross-examination of Mr. Swinburne was continued, MR. TERRELL said that he was going to show a wonderful experiment—the most wonderful he had ever seen. By means of the apparatus in Court he was, with the assistance of Mr. Duddell, F.R.S., going to write down on a screen the travelling waves of force, and by means of a transformer show how they were "damped," how they came into tune and went out of tune. It would not be an imitation wave, but a real wave that would write itself down as it travelled through space.

MR. ASTBURY said that these experiments were very interesting and extremely ingenious, but they had nothing to do with the case. One had to bear in mind that some one had to pay the costs of this action, and he hoped that his learned friend would not go more into experimentalisation than was necessary. When they once understood the technicalities, the invention itself was a very simple one.

MR. TERRELL said that Mr. Astbury might rest assured that he would not make more experiments than he thought necessary. This experiment, showing the wave and its alteration under different conditions, was very necessary to the case. Counsel pointed out that inasmuch as they were dealing with things that travelled at an enormous speed, the capacity was multiplied by 1,000, which would make the wave 1,000 times longer, but the self-induction was also multiplied by 1,000. The lights of the Court having been turned down, there appeared on the white screen a line of bright spots, and Mr. Swinburne explained that as the current passed the line of spots vibrated frequently. With such high speed as they were using they got a line made up of a succession of spots. With more capacity they got a still longer wave. The bringing in of self-induction had the same effect as increasing the capacity. The experiment had shown the effect of "damping" and the effect of tight coupling. It had also shown something that he knew before, the inductive effect of the upper part of the coil in the defendants' apparatus.

MR. TERRELL: Would these waves have the same effect on the receiver whether they had been produced by the primary circuit of the transformer or the secondary circuit?—It would not really matter, but you must, in order to get resonance, have provisional self-induction in both the primary and secondary.

If you had a good capacity in your primary, or if you had a tight coupled transformer so that you got a rushing through, you would get the same effect upon the receiver whether the primary was tuned to the secondary or not?—No. If you had that and nothing else you had no time frequency at all.

WITNESS was referring to small transformers when MR. TERRELL asked, "What do you consider a small transformer?"—WITNESS said it was, of course, a matter of degree.

The transformers shown in Marconi's specification are small transformers?—Yes, small as a matter of degree.

Comparing the specifications of Tesla with those of Marconi, having taken witness through them in considerable detail, MR. TERRELL asked whether the Marconi transformer was not practically the same as the transformer of Tesla?—Assuming that you had tuning, that was so, of course, with the difference of capacity.

Tesla wanted large capacities for his electric lighting?—Yes.

And therefore he put in large condensers?—Yes.

I put it to you, assuming equality of capacity, and assuming tuning between the discharge circuit and the aerial circuit, that the two things are identical?—Yes, assuming all that, I agree; but Marconi made it useful for wireless telegraphy.

So far as the apparatus of Tesla is concerned, assuming the tuning is the same, assuming tuning between the discharge circuit and the aerial circuit, and assuming the open circuit to be the aerial circuit, the two things are identical?—I agree.

The Tesla apparatus is used largely in the modern world?—Yes.

His was not a mere paper specification that nobody looked at?—Tesla was perfectly well known.

In answer to further questions, WITNESS said there was a good deal of nonsense in Tesla's specifications, though he was a very eminent man.

And he took the world by surprise?—Yes.

So, however eminent an electrician Tesla was, and however much he took the world by surprise, when he came to write specifications he wrote nonsense?—Yes, but a number of other eminent men have written nonsense, too.

Going to Sir Oliver Lodge, WITNESS agreed with certain qualifications that Sir Oliver treated tuning as quite an ordinary matter, which was well known and commonly known. It was also, witness said, known that it was a desirable thing before the date of Marconi's patent.

Asked with regard to the specification of Prof. Silvanus Thompson, WITNESS said that he did not think it was of much value.

MR. TERRELL said that Mr. Boys and Mr. Duddell, who were present, did not agree with that opinion.

WITNESS said he could not help that. Prof. Silvanus Thompson was a very eminent man, and a very able man, but was subject, as other good men were, to make mistakes. He had made mistakes with regard to tuning. Witness could not say whether Braun was a great electrical engineer. He knew the name well, but did not know anything about him. He might have got half the Nobel prize last year.

MR. ASTBURY asked whether Mr. Braun was going to be called. Mr. Braun, he said, was a great friend of Mr. Marconi's, so he (counsel) happened to know something about it.

MR. TERRELL to WITNESS: Do you think Braun intended to tune?—I don't think he thought of it.

But tuning was common property at that date?—I did not say so. What I said was that people who wanted to tune knew how to tune.

Was it old to tune between the primary and secondary currents of a receiver at that date?—I don't think it was well known.

Have you any idea why Marconi did not claim it?

MR. ASTBURY objected to the question, and MR. JUSTICE PARKER said that it raised a question which he had asked himself.

MR. ASTBURY: How can you ask why Mr. Marconi, in 1899, did

not claim something that he had not claimed?—Mr. Swinburne said that so far as he knew the history of tuning of the primary and secondary currents was not known. Braun did not in 1899 obtain and give to the electrical engineer all the knowledge that Marconi had. Braun conveyed no knowledge whatever. What Braun intended to convey was the advisability of using vibrations of lower frequency; but that was not information, because it was known. Braun thought it was new, but it was not new. The super-posed vibrations mentioned by Braun did not mean tuning. A number of transformers were submitted to witness, but he could not say whether they were tightly or loosely coupled, but he had no doubt that they were in accordance with Tesla's specification. Taking a diagram of the defendants' apparatus, Mr. Swinburne said that it was absolutely identical with the plaintiffs', except that it had two turns and a-half instead of one and a-half.

Mr. Terrell: Do you take the view that electricity is an existence, or that it is a motion of the ether?—It is a motion of the ether, but I don't mind which view you take.

Treating it as an existence, if you have a transformer it is not mere electricity, as it comes from the primary circuit that passes to the secondary?—Not with an ordinary transformer. In a broad sense, a transformer was an apparatus for changing energy; but in the sense of its application to wireless telegraphy, the transformer was not known before Marconi.

Referred to a patent of Sir Oliver Lodge, Witness said that Marconi's 1896 patent was just before Prof. Lodge's application for his 1897 patent.

Mr. Terrell: I said it showed that tuning was common knowledge. I certainly thought, for the purpose of trying to prove the desirability of tuning, it had been discussed by other people than Marconi?—The first patent ever taken out in the world for wireless telegraphy was by Marconi.

Do you know Sir Oliver Lodge has a system at work at Elmers End with a very large field—about 400 miles?—Yes; the system, he understood, was used on many battleships.

This concluded Mr. Swinburne's cross-examination, and Mr. Astbury was proceeding with the re-examination when the hearing was adjourned.

On December 16th Mr. Terrell said that, with his Lordship's permission, he desired to show how a foreign station could be tapped, and a few minutes to 12 o'clock would be the most convenient time.

His Lordship intimated that the evidence might be then interrupted for the purpose.

In further re-examination, Mr. Swinburne said Steinmetz was a great authority on alternating currents.

Mr. Astbury was going to read a passage from Steinmetz, dated 1905, when Mr. Terrell objected on the ground of date. Anything that was quoted, he said, should be prior to the specification of the "four sevens" patent (1900).

Mr. Astbury: Then I must get an earlier edition of Steinmetz, that is all. Steinmetz says: "The most important stationary induction apparatus is a transformer, consisting of two electric circuits interlocked with the same magnetic circuit. When using the same, or part of the same electric circuit for primary or secondary, the transformer is called a compensator or auto-transformer."

Mr. Terrell: I shall agree to that, and won't object to the book.

Mr. Astbury (to witness): Was that as true in the period prior to 1900 as it was subsequent to 1900?—Certainly. Witness then proceeded further to elucidate the details of the various forms of transformers and shunts.

Mr. Astbury referred to Prof. Silvanus Thompson's auto-transformer, and asked: "Is that not in fact a coil in which a part is a component of two circuits, and a part is not; that is of precisely the same character as the coil used on the Nonsuch?"—Yes; but it differs in degree to some extent.

Qua the question of transformer, or auto-transformer, is that relevant?—I don't think it is.

I am rather ignorant as to what my friend, Mr. Terrell, means, but assuming that he means that you are getting your current direct out of your primary into your aerial, then it is not inductive; but if you have a split between the two coils it is?—Yes.

Is it possible to help, in Mr. Terrell's sense, the current from the primary getting into the secondary?—No.

Is there any suggestion you have found in any of the documents referred to by Mr. Terrell, either of Sir Oliver Lodge, Prof. Silvanus Thompson or anyone else, except Braun, prior to 1900, to the effect that you could make a wireless apparatus by putting the aerial with the adjustable capacity on any of Tesla's figures?—No.

At 11.50 the evidence of Mr. Swinburne was interrupted for the purpose of utilising the apparatus for picking up stations.

Mr. Terrell, K.C., said: We are attempting to pick up the signals which are being sent from different wireless telegraph stations in Europe, knowing what the wave lengths are, and you will be able to see how you can get into tune with one or the other.

An operator then arranged the apparatus, and placing the receivers over his ears, listened. In the meantime a pair of receivers were handed to his Lordship, and in silence the Court awaited the result. The operator almost immediately afterwards announced that he was getting a message.

Mr. Terrell, K.C., explained that it was a German station sending the time to ships at sea.

Mr. Justice Parker said he heard some ticks.

Mr. Terrell: They go five ticks at a second each, and then they stop for a second and give five more ticks, and the last tick is Greenwich time—12 o'clock.

Mr. Terrell then asked the operator to alter the wave length a little, and he altered the coupling of the two circuits of the receiver, and then altered the inductance, so that the wave lengths had been decreased, and that stopped the signals.

Mr. Astbury, at the end of the exposition, said he could not ask Mr. Swinburne what had been happening, because he could not know.

Mr. Justice Parker: I have heard certain noises which might be described as ticks.

Mr. Walter: Dot, dash. Mr. Terrell: No, they are all short.

In further re-examination, Witness said that there was no other means of forcing vibration on an untunable area which would compare in utility with tuning. That was one of the principal bases of the Marconi patent.

Mr. Terrell asked some supplementary questions in cross-examination. He wanted, he said, to come to some definite point upon the question of infringement as to what was in dispute between them. In the first portion of the claim he read, "The transformer for electric wave telegraphy consisting of a practical producer having its terminals connected with a condenser with one circuit of the transformer and the other circuit being connected with the conductor." These words, said Mr. Terrell, might be construed to be one circuit of a two-circuit transformer, and the other circuit of a two-circuit transformer?—Yes.

Or they may be construed to mean an auto-transformer?—Yes.

Or it might include any other way of transferring energy from one set on to the other two circuits?—Yes.

That is a question for my Lord?—Yes.

What we have got to see is whether you can say that what the defendants have done comes within all these three ways of putting this claim. It is obvious that it is a question which must come in under the second and third. If the first claim named was asserted, it obviously refers to a transformer with two separate wires together. That is no essential part of the claim, and it is perfectly free to make it cover electrical equipment.

What is meant by two things being of different fundamental types. Does it mean that there is a fundamental difference between them?—Certainly.

At the conclusion of Mr. Swinburne's evidence, Mr. Terrell asked his Lordship whether, if the plaintiffs finished their case before the vacation commenced, it would not be convenient for him to postpone his opening on the part of the defendants until after the New Year? The shorthand notes, he said, would take some time to digest, and he would not care to deal with his case at once.

Mr. Justice Parker said that there were two more available days, and it all depended upon how many witnesses Mr. Astbury proposed to call.

Mr. Astbury said that all the ground had now been covered, and he did not think his other witnesses would be long. Might he say that what Mr. Terrell was proposing would be perfectly agreeable to him? He understood that the position was that Mr. Terrell wanted to know a little more about the matter.

Mr. Terrell: It would be an advantage to both of us if we could.

Mr. Dugald Clerk, F.R.S., was the next witness. He said that he had studied mechanical and electrical engineering for many years.

Have you carefully read and considered the specifications which are relative to this case which have been referred to?—Yes.

Without going into the document for a moment, but very shortly if you will, what do you understand the real advance was that was made in this "four sevens" patent?—The real advance was in separating the two circuits, one supplying the energy and the other radiating it.

The result of that combination was that instead of having one considerable wave dying rapidly away to very little, Mr. Marconi was able to send out a series of waves, each of which carried nearly as much energy as the other. By that arrangement he was able, by having this train of waves, to make it easier for a persistent receiving instrument at the other end to pick up those vibrations. That was the great advantage of Marconi's invention, and the great invention was the linking of these two circuits in such a way as not to spoil the oscillations.

Do you not find the whole invention in the defendants' apparatus as installed on the Nonsuch?—Yes.

With regard to Braun, is there anything in Braun which could have taught you anything about the plaintiffs' problem or its solution?—Braun rather tends to lead one away from it. He makes his main point that he in contradistinction used long oscillations. Marconi had already used oscillations of 800 to 1,000 m.

Apart from Braun, do you find in any of the earlier documents, whether specifications or the papers of Lodge, Tesla or Silvanus Thompson, any indication of any sort of the problem Marconi had before him and his solution or any part of it?—No.

I want a picture of a wave length so that we may know what we are talking about. The velocity of light is 300,000,000 metres a second?—Yes.

So that a frequency of 1,000,000 per second would give 300 metres?—Yes.

That gives an idea of the frequency of Mr. Marconi's wave?—Yes.

A primary circuit of that character has so many oscillations per second?—Yes.

If it has a million oscillations per second, is the time period one millionth of a second?—Yes.

Is the length of a wave travelling with the velocity of light, the velocity of light divided by this time period?—Divided by the frequency.

So you get a wave length of 300,000,000 divided by a million—namely, 300 metres?—Yes.

If you take an aerial to a capacity at one end and up in the air at the other, does the capacity of that wave increase according to its length?—Yes.

If you have a current passing along a single wire is there in effect, or is there not, some inductance by reason of that current passing?—Yes, it is self-induction.

Suppose a transmitter is made for the purpose of putting Mr. Marconi's 1900 invention into operation, and confine your mind to the merits of the problem, and not to the mere form of the device; was it not plain that a good radiator and a persistent oscillator were incompatible in the one circuit?—Yes.

In fig. 1 of the "four sevens" patent, do you not obtain the full effect of oscillation and the full effect of ample radiation?—Yes.

And is the wave sent out solely from the vertical aerial?—Yes.

Is it possible to get anything into your aerial except by means of your primary circuit?—No.

In the course of further detailed evidence, MR. DUGALD CLERK said that in Sir Oliver Lodge's specification, there were no interacting oscillatory circuits, and no inductive linkage between a closed oscillator and an open radiator.

Cross-examined by MR. TERRELL, WITNESS said that he had no very special experience of wireless. He had only studied it for this case.

You heard Mr. Swinburne's evidence?—Yes.

And you agree with him?—I do.

MR. DUGALD CLERK was further cross-examined much on the same lines as the cross-examination of Mr. Swinburne, both with the idea of showing anticipation, and on the question of the alleged infringement, and at the conclusion of his evidence, the hearing was adjourned until Tuesday, December 20th.

[Plaintiffs' evidence was concluded, and counsel was opening the case for the defendants, when the Court rose on Tuesday, and the further hearing was adjourned to next sittings.]

(To be continued.)

HORSFALL DESTRUCTOR CO., LTD.

A PETITION for the reduction of the capital of this company was before Mr. Justice Neville in the Chancery Division on Tuesday, but a difficulty having arisen with regard to 9,704 vendors' shares that had been surrendered to the company, it was found necessary that further resolutions should be passed.

No order was, accordingly, made upon the petition, the company being left to bring the matter again before the Court, when the necessary meetings had been duly convened.

MID-OXFORDSHIRE GAS LIGHT AND COKE CO., LTD., BEIRNSTEIN *v.* THE COMPANY AND OTHERS.

THIS debenture-holders' action came before Mr. Justice Neville on Tuesday upon a motion for judgment in default of defence. The debenture security was stated to comprise electric plant at Chipping Norton, and numerous receivers have been appointed of the company's various properties.

His LORDSHIP now pronounced the formal debenture decree, and directed the usual account and inquiries.

HUMMELL *v.* LONDON ELECTRIC SUPPLY CORPORATION.

ON Tuesday, at the Marlborough Street Police Court, Mr. Denman gave his decision in the case reported in our last issue, in which the London Electric Supply Corporation were summoned by Robert Henry Hummell, of 6, Old Bond Street, for having made default in supplying him with energy.

Mr. Newbolt appeared for the complainant, Mr. Marriott represented the defendant company, and Mr. W. S. Kennedy appeared to watch the case on behalf of the Westminster Electric Supply Corporation.

The Magistrate said that the summons alleged that the defendant corporation had rendered themselves liable to a penalty under the Electric Lighting Orders, No. 2 Act, 1889, for having made default in supplying the complainant with electrical energy. The facts disclosed that there had been no difficulty in obtaining a sufficient supply under the direct current system. That supply could be given at any moment under the arrangements and agreements now in force by the Westminster Electric Supply Corporation for mutual assistance and association with the defendant corporation. The complainant, however, desired to be supplied with energy on the alternating-current system, and he duly applied to the defendant corporation for such a supply. The defendant corporation were and had been willing to give an efficient supply of energy on the direct-current system, such current being provided by the Westminster Co. under the joint scheme; but they denied that they were under liability, at the call of a private consumer, to supply or procure for him a supply of any special kind of current. In these circumstances the complainant contended that the London Corporation had made default in supplying energy under Sec. 50 of the Electric Lighting Acts, and that they had rendered themselves liable to the penalties imposed by the Act. It became necessary to look at Sec. 47 of the Act of 1889 to find the effect of that enactment. Each company then operated, and could only operate within its own area, but by subsequent legislation that was no longer the case. In 1908 the London Electric Supply Act was passed to confer further powers and make further provision with regard to the supply of electrical energy in London, and that authorised, among other things, the two corporations concerned in this case, directly or indirectly, to do what they were prohibited up to that date from doing, viz., with the approval of the Board of Trade to enter into agreement for mutual assistance or association with regard to, amongst other things, the distribution of a suppy of electrical energy. By Sec. 3 they were to remain subject to all the same obligations and liabilities to other persons as they would have been subject to if such agreement had not been made. The Westminster Co. was one of the specified companies under this Act, which further provided by Sec. 3 that such companies, if they exercised the powers under the Act, were to become authorised undertakers. The London Corporation had, by various Orders and consents of the Board of Trade, been authorised to supply their electricity by the system of continuous current, and also by the system of alternating current, but they had not, in fact, at the present time the necessary apparatus for supplying continuous current by themselves directly in the district in which the complainant's premises were situated; but the Westminster Corporation had. Under the provisions and powers of the 1908 Act, an agreement had been entered into, dated May 4th, 1910, for mutual assistance or association between the two companies by Sec. 2, of which the management and working of that portion of the London Co.'s undertaking situated in Westminster, was placed in the hands of the Westminster Co. It would certainly appear that whoever drafted that agreement had in view the right of consumers to require a supply, at their own dictation, of alternating as against direct current, or at any rate that they might at any time during the existence of the agreement be so entitled. That seemed to be contemplated by Secs. 11 and 13. But that could not by itself confer any such right upon a consumer. It appeared to him to be an exceedingly difficult, and an exceedingly open, question whether on the true construction of Sec. 47 of the Act of 1889, coupled with subsequent legislation, subsequent statutory orders and regulations, and the statutory agreement, a private consumer in the district in question at the present day, was entitled to say in effect: "I dictate to you, the original undertakers, which of the two systems which you are authorised to use, you shall adopt in supplying my premises," or whether when such consumer said, "supply me under Sec. 47 of the Act of 1889, with an electrical supply," the company was not within its rights in saying, "we will do so either directly or by the aid of those with whom we are now associated, but the exigencies of the case require that you must be content with one of those two effective systems, either of which we are authorised to deal in, and we are prepared to give you the one, but not the other." He had come to the conclusion that he ought not to make any attempt to settle such a question as that on the present summons, because it was not directly before him. The defendants were supplying, or were quite ready and willing to supply, energy, so they came back to the old question in a rather more serious form—was it penal to supply energy of one authorised system when the consumer happened to fancy the other one which was also authorised. He found nothing in the Act of 1908 which carried the question of penalties any further. The consent of the Board of Trade had been given both to the use of the alternating and of the continuous systems. Those consents did no more than authorise their use by the defendant corporation on certain conditions, and did not make either of them compulsory. When he looked at the form of the Board of Trade regulations for ensuring a proper supply of electrical energy, he found it was laid down that undertakers were to declare to the consumer the system they proposed to adopt, whether alternating or continuous current, and in the case of alternating current the frequency, and so on. The defendants at the present time through the authorised undertakers, their associated corporation, had supplied, or were willing to supply, energy of a recognised and authorised type, and they had through the authorised undertakers declared the system they proposed to adopt. In his view, the section of the Act dealing with penalties only provided for their imposition in the case where a company left a consumer without a supply where he was entitled to claim to be supplied. It could not, therefore, be said that the defendants had failed to supply energy, or had made default in supplying energy in the sense which he took to be the true intent of the section; and the summons would therefore be dismissed. If the parties desired to carry the matter to the High Court, he would grant them every facility.

On the application of Mr. Marriott, the Magistrate awarded the defendant company 10 guineas costs.

South Africa.—CAPE TOWN.—In the House of Assembly, Mr. Graaff (Minister of Posts and Telegraphs), answering Mr. C. L. Botha, as to whether electrical engineering work at Bloemfontein would in future be carried out departmentally, instead of by contract, said that the work was being carried out departmentally. The course was being followed in other provinces, and there was a great deal to recommend it.

The Willowmore (Cape Province) T.C. has granted a concession for a term of years to a Johannesburg firm to light the town by electricity, the Council undertaking to pay £105 a year for 30 street lamps, which the firm will erect at its own cost. The public are to get the light at 9d. per unit, with a minimum charge of 7s. 6d per month.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Meter for Restricted-Hour System.

The attention of our readers has already been called to the above system by two articles by Mr. P. J. Pringle, which appeared in our issues of August 26th and September 2nd last, whilst further interest has been evinced by subsequent correspondence. A special time switch for use in connection with this system has now been placed on the market by Messrs. Wm. Geipel & Co., Vulcan Works, St. Thomas Street, S.E. It is made in two sizes, the larger of which has its contacts entirely immersed in oil, and is illustrated herewith.

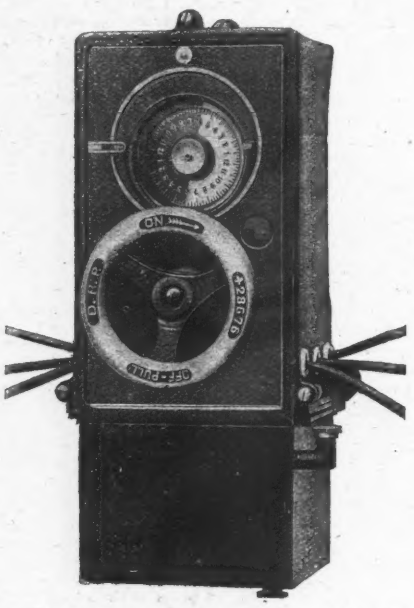


Fig. 1.—Exterior of Time Switch for 100 Amps. at 600 Volts.

Fig. 1 shows the exterior of the apparatus, with the hand-wheel controlling the main switch, and the sealing cover over the dial. Fig. 2 shows the internal mechanism, part in the case and part in the cover; A I and A II are the incoming and outgoing terminals; F the inlet and E the outlet for the oil in the switch chamber; R the winding stem; Z the dial, which can be removed by unscrewing the nut V and lifting the pointer J; K a lock nut to secure the dials after setting. When the switch is "on," a red disk appears at the little window on the right of the outer cover; to switch off, one pulls the wheel. The pointer S serves for regulating the clock.

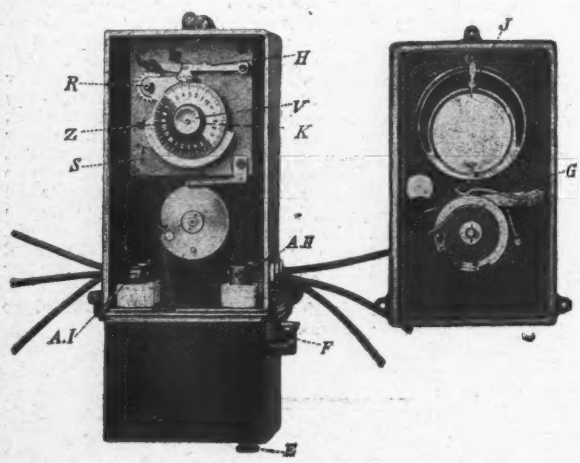


Fig. 2.—Interior of Time Switch.

The device is made for both A.C. and D.C. work, with single, double or three poles, and is provided with a counter for registering the number of hours run, so that it can be used as an hour meter. An indicator is provided, which shows the position of the clock-work spring, and reminds the customer when rewinding is necessary, whilst a further device can be added to ring a bell a few minutes before the time when the switch is due to break circuit. The supply can be instantaneously cut off in case of accident, whilst the switch is both fool and fraud proof. The dial system consists of a number of metal disks, displaced according to the time limits required, and somewhat similar to a set of playing cards.

In some undertakings the effect of the peak load is of less importance than in others, but it can be stated without question that the restricted-hour system may be applied with advantage in very many cases. A concession in the price per unit can always be made, which not only tends to increase the consumption of existing customers but brings new clients, who might not otherwise have entertained the use of electricity as a motive power or heating agent. Amongst the advantages which Mr. Pringle has set forth are the increasing of revenue without any increase in capital charges other than the "connecting on" cost; the improvement of the load factor, together with reduced cost of working; and that demands can be obtained which would be impossible with the ordinary power supply rates, owing to the low price that can be quoted. Further, the restricted-hour system has no element of risk, the rate of profit can be closely estimated, and all consumers contribute at about an equal rate.

The practical working of this system in Burton and other towns is fully explained in the articles mentioned.

New Fuse.

The British Central Electrical Co., of 84, Hatton Garden, E.C., is introducing a new pattern of fuse to comply with Regulation No. 5 of the new Factory and Workshop Act. The design is illustrated in fig. 3, from which it will be seen that the contacts and fuse-wire are entirely enclosed when the fuse carrier is in position. The scattering of hot metal is avoided, even if the fuse is replaced while the fault still exists, and the danger of accidental shock is greatly minimised. Constructively the switch is very simple, as will be gathered from our view.

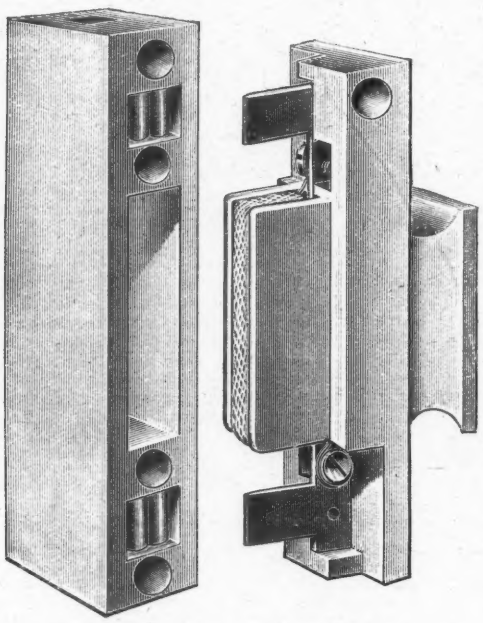


Fig. 3.—New Fuse Holder.

An Acid-Proof Label.

We have received from Messrs. Rice's Label Works, Surbiton, Surrey, some samples of their patent acid-proof labels for use when charging accumulators. The labels are specially prepared, and if the names are written in ordinary lead-pencil, will be unaffected by the acid. The labels can be re-written as often as desired, and are practically indestructible in acid; they have already been sold in thousands to central stations and motor works all over the country.

Large Electric Hot Plate.

Messrs. Eastman & Warne, of Acton Vale, W., have just constructed an exceptionally large hot plate, which forms the bed of a press intended for drying the matrix of a stereotype plate, and is required to withstand a pressure of 30 tons without distortion when hot. The temperature called for is low, not exceeding 375° F., but must be uniform over the whole surface covered by the matrix, which will be a few inches smaller than the actual heated surface. The dimensions of the hot plate proper are 27 in × 32 in., and the overall dimensions of the base 35½ in. × 32 in., with a depth from upper surface to lowest point of ribs on the under side of 8½ in. The weight is 11 cwt., and the consumption starts at about 6,000 watts, coming down to about 3,000 watts when at maximum temperature. The time required to heat up is 45 min.

The heating element consists of nickel wire wound on flat strips of uralite, laid in narrow slots, 50 in number, insulated with mica. The length of wire used is over a mile, and at the moderate temperature used, with the large area attained by the firm's system of embedding the flat strips in deep, narrow slots, there is little liability to breakdown through oxidation of the wire, with consequent broken circuit.

There would appear to be excellent prospects of a good opening for electrically-heated plates of this description to replace gas or steam-heated presses as generally used. It is far more easy to maintain a satisfactory temperature by electrical means than by steam, unless the source of steam supply is within easy reach of the plate, which is not always the case, and in this particular instance seems to have been inconvenient. The disadvantages of gas heating for the purpose are obvious and pronounced.

"Reliable" Push-Button Switch.

Messrs. A. P. Lundberg & Sons, of Liverpool Road, N., have recently added to their wonderful list of switches a push-button pivot-type switch, based on their well-known pivot-switch action.

This switch is designed for use in remote control systems as applied to electrically operated printing-presses and lifts; its workmanship is quite in keeping with Messrs. Lundberg's other products.

BUSINESS NOTES.

Bankruptcy Proceedings. — Charles Hellyer Pearson, trading as Pearson & Co., at 51A, Mosley Street, and as the "B.O.A." Engineering Co., at Stockton Street, Manchester, and as Pearson & Co., at 4, Manchester Road, Hyde, electrical engineer, &c. The following are creditors:—

Andrew, L., & Co.	£54	Ingham, Clarke & Co.	£12
Baxendale & Co.	243	Jackson, H. A., & Co.	176
Bellamy, H. E., & Co.	14	Leddaway, E., & Co.	23
Birmingham Products Co.	46	Lucy & Sunderland	15
Bridge, W. H., Ltd.	54	Monks & Clark	26
Buckley & Buckley	21	Marshall, A.	20
Banton, Delingpole & Co.	18	Metallic Seamless Tube Co.	86
Callender's Cable Co.	23	Moores, Jno.,	13
Collier, E., & Son	22	Morrison, Ingram & Co., Ltd.	15
Crawfords Coach Van Builders, Ltd.	66	"Bankers"	108
Cowburn, Ann, Ltd.	17	National Telephone Co.	12
Delta Metal Co.	33	Pearson, Isaac	104
Eckstein, Heap & Co.	29	Perfection Harmless Steel Tube Co.	19
Electric and Ordnance Accessories Co.	130	Pilkington Bros., Ltd.	41
Evershed & Vignoles	31	Roberts, W. E.	32
Fagmon, Alex., & Co.	23	Salford Paint and Varnish Co.	12
Gabriel Lamp Co.	20	Sinclair, C. A., & Co.	20
General Electric Co.	333	Smith Bros.	16
Glover, W. T., & Co., Ltd.	46	Till & Whitehead, Ltd.	12
Goodlass, Wall & Co.	14	Veritys, Ltd.	20
Gratrix, S., Jun., & Bro.	126	Walsall Hardware Manufacturing Co.	44
Harris, A. E., & Co.	35	Ward & Goldstone	17
Henley's Telegraph Works, Ltd.	96	Wilkinson, Heywood & Clarke, Ltd.	33
Hinchcliffe, T. H.	77		
Hodgkinson, James	66		

The first meeting of creditors was held at Manchester on Monday last. The statement of affairs showed liabilities amounting to £2,726, and the assets were estimated to produce £993, leaving a deficiency of £1,733. The failure was attributed to losses on contracts and bad debts. Some time ago a private meeting of the debtor's creditors was held, when a statement of affairs was presented showing liabilities £2,803, assets estimated to realise £1,014. An offer of a composition of 10s. in the £ was made, payable by four equal instalments extending over 12 months. This offer was accepted, subject to the debtor getting guarantees for the last two instalments, the meeting being adjourned for this purpose. The debtor, however, was unable to find the required guarantee and filed his petition. It transpired that the debtor started business in 1903 in Park Street, Greenheys, Manchester, as an electrical and mechanical engineer, with a capital of £50, his savings. Subsequently he took various business premises in Manchester, and eventually established himself at 51A, Mosley Street, Manchester, where he carried on business as an electrical engineer, also as a plumber and decorator. In April, 1909, the debtor purchased an electrical switch business, which he carried on at various addresses in the Hulme district of Manchester. This was the business of the B.O.A. Engineering Co., and was afterwards conducted under the management of one of the original proprietors. With the exception of a loan of £106 and a bank overdraft for £108, all the unsecured liabilities are in respect of goods supplied. The household furniture is claimed by the debtor's wife. This claim is being investigated. Mr. Yearsley (Messrs. Trotter, Davies & Yearsley), incorporated accountant, Brazennose Street, was appointed trustee with a committee of inspection.

J. G. S. Cunnington and H. P. Allison, electrical engineers and contractors, 7, Great Newport Street, London.—A second dividend of 1s. 4d. in the £ is announced, payable from December 29th, at the offices of Messrs. Josolyne Miles & Co., 28, King Street, Cheapside, E.C.

Book Notices.—*Elektrische Beleuchtung.* By Dr. Ing. Berthold Monarch. Second edition. Hanover: Dr. Max Jänecke. Price 9 m. 20 pf.—The first edition of Dr. Monarch's book was favourably reviewed in these columns in 1907, and the rapid progress in metal filament and flame arc lamps since that date has necessitated considerable additions in the present edition. These additions have been chiefly collected together in the second part, so as not to interfere with the sequence of the book as originally written. The new chapters deal with improvements in photometric methods, new arc lamps (including vapour lamps), the construction and performance of metal-filament lamps, &c. The result is a useful and comprehensive treatment of the whole subject of electric lamps and lighting brought thoroughly up to date.

Die Aufgaben der Elektrizitätsgesetzgebung. By Prof. Dr. Arnold Krasny (Manzsche K. und K. Hof-Verlags und Buchhandlung). Price 4 kr.—This book, by a well-known writer on the legal aspect of electrical undertakings, deals in an authoritative manner with the unification of Austrian law, as it concerns everything electrical. After some preliminary pages on the present status of electrical undertakings in Austria and other countries, together with a discussion of the existing relevant laws, the writer proceeds, in the second part of the book, to formulate a suggested complete "law of electrical undertakings." This deals in considerable detail with the regulation of both heavy and small-current installations from their first inception onwards, and is arranged, as far as possible, to fall into line with the existing Austrian law on railways, telegraphs, &c. Part III is confined to explanations and amplifications of the various clauses of the suggested law. Although more especially concerned with Austrian conditions, the book forms an interesting comment on the state of the law in other countries, and gives valuable hints as to the directions in which alterations or additions are most pressingly needed.

"*Transactions* of the Illuminating Engineering Society." Vol. V, No. 8. November, 1910. Easton, Pa.: The Society. Price $1.

"Fortschritte der Elektrotechnik." By Karl Strecker. 1910. Berlin: Julius Springer. Price 9 m.

"*Proceedings* of the American Institute of Electrical Engineers." Vol. XXIX, No. 12. December, 1910. New York: The Institute. Price $1.

"Papers and Reports Relating to Minerals and Mining in New Zealand." 1910. Wellington: John Mackay.

"*Journal* of the American Society of Mechanical Engineers." December, 1910. Baltimore, Md.: *The Society.* Price $1.

"Automobile Engineering for 1911." London: *Automobile Engineer* Publishing Co., Ltd. Price 1s. net.

"*Proceedings* of the Physical Society of London." Vol. XXII, part 4, November, 1910. London: Taylor & Francis.

"Underfeed" Stoker Contracts.—Among the stoker orders recently received by the Underfeed Stoker Co., Ltd., are the following:—

Woolwich Arsenal (repeat), 2 E; Portsmouth Dockyard, 4 E; Northampton Electric Light Co. (repeat), 1 E; Belliss & Morcom, Birmingham (repeat), 1 D; Walsall Corporation (repeat), 1 E; Sulzer Bros., Winterthur, 1 A; Mount Lyell Mines, Australia, 4 E; Hanshin Electric Railway, 4 E; Campanhia Allemana Transatlantica, Buenos Ayres, 2 E.

Private Meetings.—John Henry Brice and William James Dean, trading as Brice, Dean & Co., 405-7, Norwood Road, West Norwood, and also formerly as W. J. Dean & Co., at Hand Court, Holborn, W.C., electrical engineers, &c.—The creditors of the above were called together on Monday, last week, when a statement of affairs showing the position as at November 29th last was presented. This disclosed liabilities of £1,501, of which £661 was due to unsecured trade creditors, while Mr. W. T. Lewis, the vendor of the Norwood business, was scheduled as a creditor for £330. Mr. O. Nettlefold appeared as a partly secured creditor for £500. The security he held was estimated at £189, and the balance of £311 was included with the unsecured liabilities. There were also private creditors for loans amounting to £200. The assets were estimated to realise £1,057, from which had to be deducted £69 for preferred claims, leaving net assets of £988, or a deficiency of £514. The company carried on business at Hand Court, and the concern became a limited company on November 1st last. The company took over the stock, plant and machinery, but it did not take over the book debts or all the liabilities. The book debts and the liabilities were of about the same value. During the year ended October 31st last, the trading at Norwood showed a gross profit at the rate of 36 per cent., but the net result was a loss of £90. Owing to proceedings having been commenced, a deed of assignment had already been executed to Mr. G. J. Toy, chartered accountant, South Place, Finsbury, E.C. A resolution was proposed that the deed should be confirmed and a committee of inspection appointed. An amendment was suggested for the meeting to be adjourned and a further investigation made. The amendment, however, was defeated by a large majority, and it was unanimously decided to confirm the deed already executed to Mr. Toy. The representatives of the following were elected as a committee of inspection: Nettlefold & Sons, Ltd.; The Standard Electric Co., Ltd.; Evered & Co., Ltd.; Marples & Sons, Ltd.; and Messrs. M. Ramsey & Co. The trustee and Committee were empowered to accept an offer of not less than 6s. 8d. in £, on behalf of the general body of creditors.

An Edmonton Installation.—The electric power and lighting installation at the works of the Crude Rubber Washing Co., Ltd., at Balham Road, Edmonton, was carried out by Messrs. A. W. Penrose & Co., Ltd.

Trade Announcements.—Mr. Reginald R. Todd announces that on and after January 1st next, Messrs. Felten and Guilleaume's agency (for insulated wires and cables for electric lighting and transmission of power, for rail bonds and rubber manufactures) will be conducted under his name at 334, Birkbeck Bank Chambers, W.C. For the last eight years the agency as mentioned above has been arranged by Mr. Todd, first under Messrs. W. F. Dennis & Co., and subsequently under the Lahmeyer Electrical Co., Ltd.

The Car and General Insurance Corporation, Ltd., of 1, Queen Victoria Street, E.C., ask our readers not to confuse them with the Law Car and General Insurance Corporation, Ltd., which is in liquidation.

Consequent upon increased business, Mr. J. Conway Price, advertising specialist, has taken an additional room at 151, Fleet Street, E.C., as a studio.

Messrs. Siemens Bros. Dynamo Works, Ltd., announce that their store and showroom at 39, Upper Thames Street, E.C., will be closed on Monday and Tuesday, 26th and 27th inst., for the holidays. They will also be closed for stocktaking on Friday and Saturday, 30th and 31st inst.

Messrs. Dr. Heinr. Traun & Sons, London agency, removed on December 21st to larger premises at 23A, Goswell Road, E.C.

Messrs. R. S. Price, Ltd., announce that from to-morrow, December 24th, their address will be Eldon Street House, Eldon Street, London, E.C., where they have taken larger premises.

Buenos Ayres Awards.—The India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., Silvertown, London, E., have received the following awards for their display at the Railway and Land Transport Exhibition held at Buenos Ayres :—Three Grand Prizes for brake hoses, motor tires and cycle tires ; Gold Medal for india-rubber tiling ; Diploma of Honour for telegraphic apparatus.

Messrs. W. T. Henley's Telegraph Works Co., Ltd., had what we believe was the only award granted to a British manufacturer for wires and cables, conferred upon them by the International jury of the Buenos Ayres Railway and Transport Exhibition. They received a Diploma of Honour.

The exhibit of Messrs. "Sylverlyte" (1909), Ltd., showing "Sylverlyte" lamps at this exhibition has been awarded a Gold Medal. "Sylverlyte" lenses also secured the Gold Medal at the International Exhibition recently held in Brussels.

Messrs. J. W. Brooke & Co., Ltd., Lowestoft, inform us that their "Brooke" motors have been awarded the Grand Prize (Diploma De Gran Premio), and also the Gold Medal (Diploma De Medalla De Oro).

Messrs. C. A. Vandervell & Co. exhibited a full range of their manufactures at the International Transport Exhibition at Buenos Ayres, and their exhibit has been awarded the Gold Medal.

Arc Works Benefit Society.—The annual meeting of the Arc Works Voluntary Sick Benefit Society was held in the Recreation Room at the Arc Works on Saturday, December 10th, Mr. Claud Crompton presiding. The report for the year showed that the contributions to the general fund amounted to £263 ; the donations from Messrs. Crompton & Co., Ltd., for additional sick pay were £68. The total receipts to the general fund were £331. The expenditure had been by sick pay £266 ; management expenses were only £20, leaving a balance in hand for distribution of £45. Funeral claims were £113. The reserve fund shows a balance at the bank of £102. Mr. W. G. Bickmore was re-elected secretary. The annual meeting of the subscribers of the Arc Works Voluntary Infirmary and Dispensary Fund was subsequently held, Mr. C. Crompton again presiding. Later the chairman read the report of the Arc Works Benevolent Fund, which is supported entirely by the directors of Messrs. Crompton & Co., Ltd. The total amount granted during the year was £11 8s., which was paid in sums varying from 5s. to 7s. per week. The thanks of the meeting were accorded to the directors for their support and interest in connection with all the institutions of the Arc Works which conduced to the welfare, pleasure and comfort of their employés and also of their employés' wives and children. A vote of thanks to the chairman brought the proceedings to a close.

Catalogues and Calendars.—A very substantial and serviceable desk companion has been received from Messrs. Bruce Peebles & Co., Ltd., of Edinburgh. It takes the form of a blotting pad with a calendar for the entire year neatly arranged along the top border. On the left, instead of the diary which is given with some other pads of a similar kind, there is a book composed of a good supply of squared paper, ruled ten lines to the inch, and a few pages of tabulated data and illustrations of the firm's electric plant manufactures, also abridged specifications and approximate price lists of same.

Messrs. W. V. Waite & Co., Ltd., of 31, Queen Street, Cardiff. —We have received a wall calendar of the perpetual type with three disks with knobs for changing respectively the month, the date and the day. For each of the days a different name appears, so that in the week names are shown of all of the firms represented by Messrs. Waite.

The Finsbury Office Furnishing Co., of 46, Finsbury Pavement, E.C., are circulating a neat desk-standing calendar (monthly cards) for 1911.

The Union Electric Co., Ltd., Park Street, Southwark, S.E. —New hanging calendar, with small monthly slips. The cards are also issued as show-cards, without the monthly slips, but with contractor's name printed. In either form the card is a telling advertisement of the "Excello" lamps.

Messrs. Pinchin Johnson & Co., Ltd., Minerva House, 26 and 27, Bevis Marks, London, E.C.—New and revised descriptive list of their "Standard" insulating varieties and compounds, with notes on their uses and applications, with some admirable half-tone pictures of electrical machinery by well-known makers, in the manufacture of which the "Standard" specialities are used.

Once again Messrs. Siemens Brothers & Co., Ltd., and Siemens Brothers Dynamo Works, Ltd., are favouring their friends with the anticipated pocket-book and diary for the coming year. Some useful table matter is followed by illustrations of Siemens manufactures. Ample daily space is left for diary notes. At the end there is a separate memoranda booklet, and the whole is nicely bound, with pencil at back edge.

The D.P. Battery Co., Ltd., Bakewell, Derbyshire.—A hanging calendar with monthly tear-off slips for 1911 has been issued. A charming view in colour of Lathkill Dale, near the works of the company, is this year's feature.

Detroit Engine Works, Gamage Building, Holborn, London, E.C.—Circular briefly describing and stating prices of the Detroit electric lighting and pumping outfits (2 to 6 H.P.) running on petrol or paraffin.

The Western Electric Co., Ltd., North Woolwich, London.— Bulletin No. 4,004 (24 pages) contains descriptive matter, and well-executed illustrations of Western Electric telephone switchboards and instruments, also neatly tabulated figures, prices, and code-words. A number of small booklets have also been received as follows :—No. 101, cable terminals for outdoor and indoor line construction ; No. 102, improved condensers for telephone and telegraph service ; No. 103, protectors for telephone circuits ; No. 104, aerial cable and line construction specialities ; also bulletin No. 4,003, relating to Western Interphones (private line telephones and installation accessories).

Messrs. Thos. W. Ward, Ltd., Albion Works, Sheffield.—160-page new catalogue of machinery, engineers' tools, and power plant. The book is fully illustrated, with tabulated sizes, prices, and code-words, and its contents cover electric winches and cranes, dynamos and motors, and other electrical plant, suction gas plants, boilers, gas, steam, oil and other engines, machine tools, &c., of most kinds. Readers interested in this class of trade can obtain a copy of the catalogue on application.

Messrs. Crompton & Co., Ltd., Salisbury House, London Wall, E.C.—32-page list (P25) in their standard form, fully describing their enclosed type arc lamps, and giving neat half-tone interior and exterior illustrations, also clearly setting out prices of both lamps and various accessorial parts.

The Globe Electric Co., Ltd., 11, Farringdon Avenue, London, E.C.—New pamphlet M15 describing, illustrating and tabulating prices of the "Multax" long-burning flame lamp which was placed on the market early in the year, and which we learn has been adopted by several corporations and railway companies at home and abroad. The prices of carbons have been considerably reduced.

The Peel-Conner Telephone Works, Ltd., Peel Works, Adelphi, Salford.—Brochure produced in tasteful style, issued as a souvenir of the recent official inspection of the Glasgow new Central Telephone Exchange. Reports of the proceedings on that occasion, and of the speeches then delivered by Mr. H. Hirst, Mr. A. M. Ogilvie, and Mr. M. S. Conner, are given, accompanied by a general description of the exchange with a number of half-tone illustrations showing the equipment, &c.

Messrs. A. Emanuel & Sons Ltd., 13, George Street, Manchester Square, London, W.—Art paper catalogue of more than a hundred pages illustrating a variety of designs of artistic electric light fittings and sundries, many of which are manufactured in the firm's own works. The fittings shown comprise brass and wrought-iron brackets, ceiling fittings, cord pendants, brass and wrought-iron lanterns, many neat and excellent lines in pendant fittings, wrought-iron and brass electroliers, billiard-room fittings, table and floor standards, outside lanterns, and shop window devices and electric signs, street lamps, ship fittings, reflectors, candle fittings, also switch-plates and parts.

The Sterling Telephone and Electric Co., Ltd., 200, Upper Thames Street, London, E.C.—Publication No. 173 contains an illustrated and priced description, with diagrams of connections, of the "Sterling" system of automatic interphones.

Messrs. Tetley & Co., Falcon Electrical Works, Bedford Street, Greengate, Salford. — Price leaflet particularising their latest designs of accumulator switchboards.

Messrs. Simplex Conduits, Ltd., 116, Charing Cross Road, W.C. —We have received from the managing director, Mr. L. M. Waterhouse, a neat leather-bound pocket book and diary, in sectional paper, with one week to an opening—an arrangement which, from experience with the similar souvenirs sent in previous years, we know to be extremely convenient. A few pages are added—not enough to burden the pocket—giving useful data regarding the Simplex conduits, fittings, wires, &c., and electrical engineering data in general, with an index, the whole forming a handy pocket companion. We have also received from the London office of the company an *edition de luxe*, consisting of a very handsome leather case with pockets for stamps, cards, &c., containing a similar pocket book and diary ; this is an exceptionally convenient and durable device, and can be used again and again with refills. We are not surprised to learn that the stock is already exhausted !

Liquidations.—Telegraph and Telephone Instruments, Ltd.—A meeting is to be held on January 25th, at 25, Victoria Street, S.W., to hear an account of the winding up from the liquidators, Messrs. A. Baker and J. H. Webb.

Schmidt's Superheating Co., Ltd.—A meeting is shortly to be held at 28, Victoria Street, S.W., to hear an account of the winding up from the liquidator, Mr. W. T. Norton.

Phosphor Bronze Co., Ltd., 87, Sumner Street, Southwark.— A first return to contributories of 7s. 6d. in the £ is payable December 22nd, at the offices of the liquidator, 8, Fredericks Place, Old Jewry, London, E.C.

A Glasgow Contract.—Some discussion took place at the last meeting of the T.C. in connection with the proposal of Works and Stores Committee of the Tramways Department to accept the offer of the United States Steel Products Co. for the supply of a quantity of copper rail-bonds. In Committee it was suggested that preference should be given to the lowest home offerers, the British Insulated and Helsby Cables, Ltd., but this had been defeated by the casting vote of the chairman. Some questions were

put to the convener (Bailie Russell) in Council, the reply being that there were two American offers, one of £140 and the other £141, while the British firm's figure was £144. He explained that the Committee had gone upon the principle of accepting the lowest of all offers, a practice which he hoped would continue. Bailie W. F. Anderson thought that for the difference of a few pounds the contract should go to a British firm and the best cable-makers in the world. Bailie P. S. Stewart argued that by accepting the lowest of all the offers here an effort would be made to break up a ring formed for the purpose of keeping up prices. He objected to the Corporation as a public body supporting any ring, and he knew that the convener was a great Tariff Reformer. Mr. James Stewart (Townhead) said that to plead that the Corporation should keep this contract in the country for the benefit of their own workmen was nonsense. The amount of labour was infinitesimal, and the wages which would be paid in America for the work would be twice or three times the amount paid here. The minutes were approved.

The Holidays.—MESSRS. WATSON, LAIDLAW & CO., LTD., of Glasgow, announce that their works and drawing office will be closed for the New Year holidays on December 31st and re-opened on January 6th. The counting-house will re-open on January 4th.

The Prescot works of the BRITISH INSULATED AND HELSBY CABLES, LTD., will be closed from Monday next, December 26th, to Saturday, December 31st, inclusive, for the holidays and stock-taking. An office staff will attend to correspondence.

MESSRS. MAWDSLEY'S, LTD., of Dursley, announce that their works will be closed from to-day, Friday, December 23rd, until the morning of Monday, January 2nd.

LIGHTING and POWER NOTES.

Aberdeen.—The annual inspection of the Corporation electricity works by the T.C. took place last week. In the course of an address, Councillor Gibb, the recently appointed convener of the Electricity Committee, referred to the revolution caused by the introduction of the metal-filament lamp. They would be interested to know, however, that the temporary setback in output due to this cause appeared to be at an end. The consumption for some months past had been going up by leaps and bounds, and they would shortly have to consider the advisability of installing more plant to enable them to fulfil their obligations next winter.

Abertillery.—The Electricity Committee having approved various extensions of public and private lighting, the Council has decided to apply for a loan of £3,000.

Bacup.—The Rawtenstall Corporation on Thursday last, approved a draft agreement for selling electricity in bulk to the Bacup T.C. The latter authority has already obtained sanction from the L.G.B. for the borrowing of £3,000 for mains, meters, and other appurtenances required for the distribution of the current, and the work of laying the mains and erecting a transformer station, is to be proceeded with without delay.

Barnes.—The electrical engineer reported at the last meeting as to the necessity for the extension of the generating plant. The maximum demand during the winter 1909-10 was 505 KW., since when 500 consumers had been connected. It would appear that the demand will this year exceed 600 KW., and the maximum load during the winter 1911-12 would be over 700 KW. He submitted plans showing the general arrangement of the proposed extension, which would consist of a 600-KW. steam dynamo, with condensing plant capable of dealing with a capacity of 1,200 KW., to allow of a similar set being installed at a later date. There would be a water-tube boiler fitted with machine stokers, and capable of evaporating 20,000 lb. per hour, with water purification plant and all auxiliaries. He estimated the entire cost at £10,000, made up as follows:—River work and pumping, £350; pump room equipment, £330; water storage tanks with frame, £110; water softening plant, £200; hot well, £60; feed pumps, £250; water-tube boiler and stoker, £2,150; steam and feed piping and valves, £200; steam dynamo, £3,700; condensers with air pumps only, £750; switchgear and connections, £290; foundations, £330; extension of offices and furnishing, £300; contingencies, &c., £980. The Council approved the report, and directed that the works be carried out. The electrical engineer was directed to report upon the question of equipping one of the existing 150-KW. sets with an internal combustion engine, as a stand-by plant.

Beckenham.—The Council has taken shop premises in High Street for an electrical showroom, and hopes to have them fitted up and opened by Christmas, showing the latest in electric light and heating appliances.

The public lighting of that part of Shortlands in the district of Beckenham has given dissatisfaction for a long time past, and now the Council has decided to take it over and supply electric lighting from its own works. The cost is to be met out of the district fund, and 70-C.P. lamps will be used.

Belfast.—At the fortnightly meeting of the Tramways and Electrical Committee, the electrical engineer reported that considerable progress had been made in connection with the proposed Electrical Exhibition in the Ulster Hall during the two weeks commencing January 9th, and that it promised to be a great success.

Bognor.—The U.D.C. on Friday decided, by 7 votes to 2, not to rescind a resolution to apply for a prov. order; at the same time it was decided to oppose a similar application by the Chichester E.L. Co. The chairman of the local gas company, who is a member of the Council, has intimated that he will move that the ratepayers be canvassed on the matter.

Broadstairs.—The U.D.C. has accepted the offer of the Isle of Thanet Traction and Lighting Co. for five electric arc lamps for lighting the High Street, at £50 per annum, inclusive.

Canada.—Our Canadian correspondent writes as follows:—The city of Toronto has recently witnessed demonstrations of street lighting which are very creditable to the city's engineers, for with the introduction of the tungsten lamp for street lighting, a much more uniform and less glaring effect has been secured. For the business streets of Toronto, clusters of five lights on ornamental iron pillars have been adopted, and for the residential street lighting, single lights attached to concrete poles. In the business section the lights are fed from underground wires. The purpose is to eliminate entirely from the central part of the city the arc lamps. The effect on the streets already lit by the new lamps has been so pleasing that there is no doubt the demand for the new lighting system will be so incessant that the whole of the city streets will be so equipped.

Ottawa is making a move to follow Toronto's example. A plan has been formulated to erect a "great white way" in several of the main business streets, which will be equipped in the same manner as at Toronto, with clusters of tungsten lamps. Hard knocks were recently handed out by the executive of the allied Trade Unionists against the management of the Ottawa civic electric plant. The new lighting system for the chief business streets was, it appears, planned and suggested by the Ottawa Electric Co., while the management of the city plant made no move. At the eleventh hour the civic management came forward and stated that it would equip the streets with the new system at "half the cost" that the Ottawa Electric Co. proposed. The Trades Council, therefore, favoured the carrying out of the scheme by the company, though the cost will be considerably higher. "Just so long," they say, "as the somnolent state exists with our municipal electric plant management, it will be necessary for the citizens to make use of advanced methods from private sources." "The whole thing is," said one delegate, "that one management (private company) is wide awake, and the other (municipal) sleeps."

Some statements as to electric light and power rates in various places in Canada may be of interest to European readers: Street Lights.—Ottawa (municipal), $45; Montreal (company), $83·95; Toronto (company), $69·35; Winnipeg (company), $61·12; Vancouver (company), $38·00; Quebec (company), $62·12; Guelph (municipal), $60·00; Calgary (municipal), $156·00; Port Arthur (municipal), $48·00. Power can be obtained in Ottawa from $17·50, and private lighting for 7½ cents per KW.-hour. At Port Arthur power is obtained at $25, and private lighting from 6 cents to 10 cents per KW.-hour. At Toronto the rate is 8 cents, and at Winnipeg 9 cents.

By the end of the present month the entire 290 miles of hydro-electric transmission, carrying Niagara energy at a pressure of 110,000 volts to all the chief centres of Ontario, west of Toronto, will be completed and in operation.

Ceylon.—A correspondent writes to inform us that the first mosque to be lighted by electricity in Ceylon, has just been completed at Colombo. A complete lighting installation with distribution boards on each floor was carried out by Mr. A. E. Holsinger, of Colombo; 75 lamps are installed, mostly of the metal-filament type; the wires, distribution boards, &c., were supplied by the Metallic Seamless Tube Co., and some outdoor fittings by the General Electric Co.

Clitheroe.—In view of the expiration of the Electric Lighting Order, the T.C. is taking into consideration the question of electric lighting.

Colwyn Bay.—The U.D.C. has decided to make an amended application to the L.G.B. for a loan of £2,710 for electricity purposes.

Continental Notes.—FRANCE.—The erection of a hydro-electric station at the falls styled Sant-de-la-Canche, in the department of Saône-et-Loire, is projected. The promoters obtained official authorisation two years ago. The works will be of more than ordinary capacity, allowing of the distribution of current at a very moderate price, which will, it is believed, tend to the creation of new industries in this region.—*Revue Pratique de l'Electricité.*

A company, with a capital of 25,000,000 fr., has been constituted at Cantelen, in the Département du Nord, to build a generating station for the supply of light and motive power to the manufacturing city of Lille and adjacent communes.—*Revue Pratique de l'Electricité.*

The powerful Compagnie Générale de l'Electricité, which boasts the ownership of 14 electric works, of which six are central stations, and a staff of 4,000 employés, has approached the T.C. of Meaux with a view to obtaining a concession for the lighting of the city. The company offers to erect a generating station of 400,000 KW. capacity and to lay down a 15-km. cable network, and to allow the city a return of 2 per cent. of the lighting receipts and 2½ per cent. of those from power. To the public subscribing three months before the starting of the works, free installation of fittings

is accorded. The concession is to run for 30 years, but the city will have the right to buy out the company at any time.—*Revue Pratique de l'Electricité.*

Holland.—Electric light and power projects are reported to be contemplated at Kollurmesland and Nieuw Kruisland, and also at Zeist, the last-named at a cost of 200,000 fl.—*Revue Pratique de l'Electricité.*

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Grimsby.—The electrical engineer (Mr. W. A. Vignoles) has prepared a scheme for lighting the market by electricity.

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London.—Shoreditch.—Owing to the rapidly-increasing demand for electricity during the present year, the existing main feeders between Whiston Street power station and Coronet Street, and from Coronet Street to the Finsbury Market area, are now being used to their maximum carrying capacity, and it is not possible to use the plant at Whiston Street to its fullest extent without additional mains being laid down. In view of the supply now given to the Great Northern and City Railway, and the linking-up main between Poole Street generating station and Coronet Street, it is found desirable to increase the carrying capacity of the mains between these points. The Lighting Committee points out that no capital expenditure on main feeders has been incurred for several years owing to the benefits derived from the change of pressure of supply. A total estimate of £8,978 is now submitted by the electrical engineer, the whole including £951 for small extensions of distributing mains in order to supply new consumers; new main feeders, £6,247, the bulk of which will be expended during the early spring and summer of next year, and £1,780 for services to consumers. The Committee has approved of the proposed expenditure.

Maidstone.—A L.G.B. inquiry was held on December 13th into the application of the T.C. for a loan of £4,000 for electric light purposes. There was opposition on behalf of the gas company and others.

Newark.—At a meeting of the T.C. on Monday, the General Purposes Committee reported the receipt of a letter from the B. of T. proposing to revoke the electric lighting orders of the Council unless it could show sufficient reason for their continuance. The Committee replied that owing to the large expenditure of the last few years on other matters, the Council had not been prepared to undertake the supply of electricity itself, but it considered that it was in the interest of the ratepayers that the orders should not be revoked. A letter was also received from Mr. Pullan in reference to a proposed private company, stating that he could not give information of the financial position of the company.

Newcastle-on-Tyne.—The Newcastle Electric Supply Co. has applied to the B. of T. for consent to place extra H.T. electric lines above the ground from the switch house at the Rising Sun Pit, Benton, to a sub-station at Backworth, and from a sub-station at East Holywell Colliery to a sub-station at Seghill Colliery.

St. Albans.—The North Metropolitan Electric Power Distribution Co. has applied to the R.D.C. for permission to supply electricity in the district, which is being largely developed.

Sandwich.—The T.C. has decided, before supporting or opposing the application for a prov. order for electric supply, to obtain a copy of the order being applied for by a local company.

Southampton.—Owing to the very large number of lighting consumers recently connected up in the Shirley district, the main from the Western Shore works to Shirley is to be duplicated at an estimated cost of £1,350, and £550 is to be spent in strengthening the main at the town side of Howard Road. Some time ago the duplication of the Portswood mains as far as Stag Gates was authorised. The electrical engineer reports that it is fortunate that this work has been carried out, otherwise the additional lighting demands could not have been coped with. The electrical engineer points out that last year the increased sales of energy amounted to nearly £5,000.

(*Continued on page* 1031.)

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Launceston.—At a meeting of the T.C. on Monday, the chairman of the Lighting Committee asked that the Council should authorise the town clerk to get an expert to advise the Council with regard to the protection of its rights in respect of the Launceston Gas Co.'s proposed application for a prov. order, and also on the draft of an agreement with the New Development Co., Ltd., with reference to supplying the town with electric light. The town clerk stated that there were one or two points in the Gas Co.'s proposed provisional order that would need attention. He had not seen a copy of the order, but he understood that there was no clause inserted as to purchase. The necessary permission was given. The town clerk pointed out that in the opinion of Mr. MacMorran it was doubtful whether the members of the Council who were members of the Gas Co. could take part in the discussion or vote on the matter of electric lighting.

Leicester.—On the death of the late Mr. Alfred Colson, the Corporation appointed a special Committee to consider the question of the amalgamation of the electric light department and the tramways power department, with a view to working the two with greater efficiency and economy. The Committee appointed Mr. James Swinburne as its adviser in the matter. It is now understood that Mr. Swinburne has reported in favour of the two electrical departments being "linked up" with a view to the spare plant being utilised to its fullest capacity. He has advised that the two departments would, under such an arrangement, be worked with greater economy than at present, and with more benefit to the public. The suggested amalgamation would, it is estimated, result in the saving of about £2,000 per annum. The Committee, it is stated, has decided to act upon Mr. Swinburne's advice, and will recommend the T.C. to adopt his suggestion, and in the event of the Council agreeing to that course, to appoint the Tramways Committee to control the joint undertaking.

London.—Shoreditch.—Owing to the rapidly-increasing demand for electricity during the present year, the existing main feeders between Whiston Street power station and Coronet Street, and from Coronet Street to the Finsbury Market area, are now being used to their maximum carrying capacity, and it is not possible to use the plant at Whiston Street to its fullest extent without additional mains being laid down. In view of the supply now given to the Great Northern and City Railway, and the linking-up main between Poole Street generating station and Coronet Street, it is found desirable to increase the carrying capacity of the mains between these points. The Lighting Committee points out that no capital expenditure on main feeders has been incurred for several years owing to the benefits derived from the change of pressure of supply. A total estimate of £8,978 is now submitted by the electrical engineer, the whole including £951 for small extensions of distributing mains in order to supply new consumers; new main feeders, £6,247, the bulk of which will be expended during the early spring and summer of next year, and £1,780 for services to consumers. The Committee has approved of the proposed expenditure.

Maidstone.—A L.G.B. inquiry was held on December 13th into the application of the T.C. for a loan of £4,000 for electric light purposes. There was opposition on behalf of the gas company and others.

Newark.—At a meeting of the T.C. on Monday, the General Purposes Committee reported the receipt of a letter from the B. of T. proposing to revoke the electric lighting orders of the Council unless it could show sufficient reason for their continuance. The Committee replied that owing to the large expenditure of the last few years on other matters, the Council had not been prepared to undertake the supply of electricity itself, but it considered that it was in the interest of the ratepayers that the orders should not be revoked. A letter was also received from Mr. Pullan in reference to a proposed private company, stating that he could not give information of the financial position of the company.

Newcastle-on-Tyne.—The Newcastle Electric Supply Co. has applied to the B. of T. for consent to place extra H.T. electric lines above the ground from the switch house at the Rising Sun Pit, Benton, to a sub-station at Backworth, and from a sub-station at East Holywell Colliery to a sub-station at Seghill Colliery.

St. Albans.—The North Metropolitan Electric Power Distribution Co. has applied to the R.D.C. for permission to supply electricity in the district, which is being largely developed.

Sandwich.—The T.C. has decided, before supporting or opposing the application for a prov. order for electric supply, to obtain a copy of the order being applied for by a local company.

Southampton.—Owing to the very large number of lighting consumers recently connected up in the Shirley district, the main from the Western Shore works to Shirley is to be duplicated at an estimated cost of £1,350, and £550 is to be spent in strengthening the main at the town side of Howard Road. Some time ago the duplication of the Portswood mains as far as Stag Gates was authorised. The electrical engineer reports that it is fortunate that this work has been carried out, otherwise the additional lighting demands could not have been coped with. The electrical engineer points out that last year the increased sales of energy amounted to nearly £5,000.

(*Continued on page* 1031.)

ELECTRIC DRIVING OF TEXTILE MACHINERY.

THE RAY MILLS, STALYBRIDGE.

We make no apology for again writing on this subject, though it has received much prominence in our columns during the past few years.

Fig. 1.—General View of the Ray Mills, Stalybridge.

New mills are from time to time being erected in the textile districts, and there are many instances where the existing power plant is getting old and worn out: in both cases it behoves central station engineers to make every effort to secure the load, while for manufacturers of electrical plant there is scope not only in England but also in Mexico, Brazil, India and other countries, where mills are springing up in considerable numbers.

There is a good deal of scepticism, and in some instances prejudice, existing among textile people, and even amongst engineers, as to the advantages to be gained by electric driving, and it is for the members of that profession whose interests the Electrical Review has at heart, to show that electric driving possesses many points of superiority over other systems. At the same time, it is folly to over-rate these systems and to claim advantages which only exist in the minds of those eager to sell plant or supply energy.

That mistakes have been made in the past tending to discredit electricity as a motive power among textile manufacturers is quite true, but that its use in textile work has come to stay and to extend very largely, is certain.

The Institution of Electrical Engineers has interested itself in this subject to the extent of appointing a special committee to inquire into it, and, taken as a whole, mill managers and others concerned are quite willing to give electrical engineers a fair hearing.

One of the great arguments used in favour of electric driving is that greater uniformity of speed is obtained, and that as a consequence, the yarn is more even; and this has been proved to be the case even when comparing the most modern steam and electric drives. Where an engine twenty or more years old is in use, the fact is not open to question; but electrical engineers should remember that while they are using the argument some engine-builder is probably using the same one with effect, and the real competition is therefore between *modern* plant of both types. The same remark holds good, we believe, in regard to relative *cost* of steam and electric drives provided that all costs, capital charges, maintenance, repairs, &c., are taken into consideration in each case. In previous articles—notably, in the description of the electric driving at the Mersey Mills (Electrical Review, April 29th, 1910, p. 693)—we have shown that the mill-owners themselves have expressed their complete satisfaction with the results obtained by replacing a highly efficient mechanical transmission by an electrical system; and the fact that the Ray Mills have been driven by electric motors from the commencement affords a striking confirmation of this statement.

There are, in most cases, three possible courses open for the driving of a mill, viz.:—(*a*) Steam engine, with the usual rope drives; (*b*) electric power generated on the premises; (*c*) electric power obtained from an outside source.

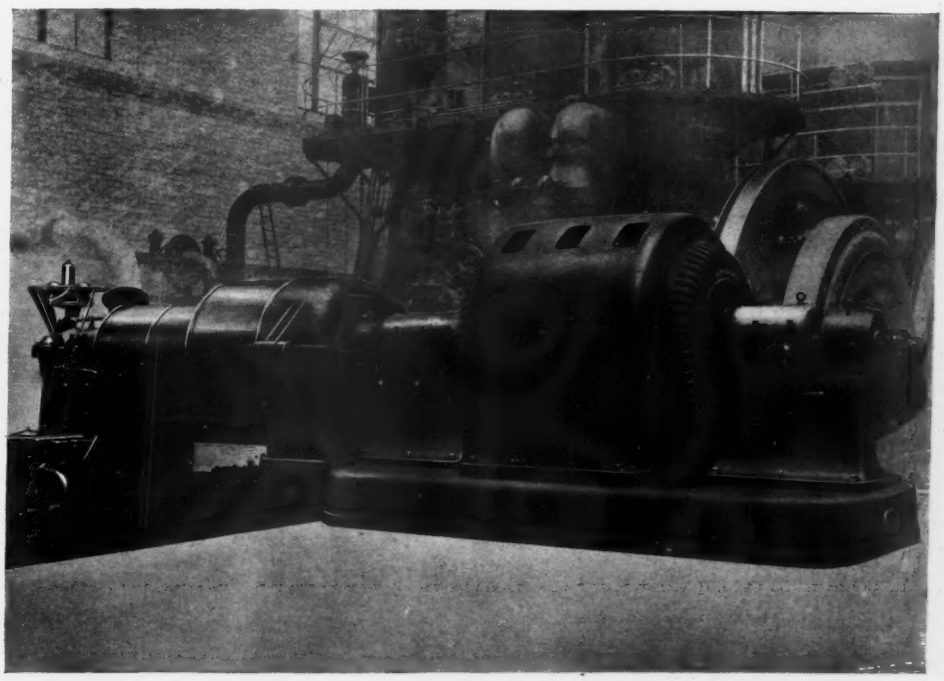


Fig. 2.—2,000-kw. Turbo-Alternator, Stalybridge Joint Board's Power Station.

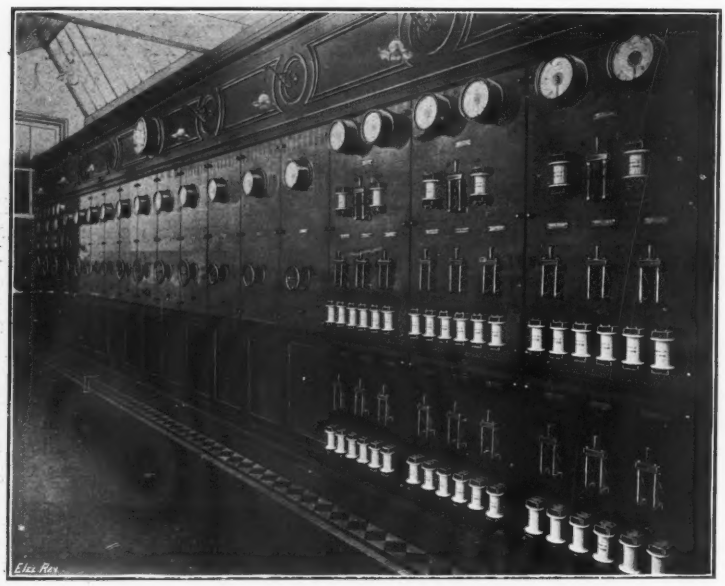


Fig. 3.—Main Switchboard.

While the commercial advantages of electric driving have been amply demonstrated, it is not equally certain that the actual running cost is materially cheaper than that of a modern steam drive. Unfortunately, there is little, if any, satisfactory evidence on this point, though there are strong grounds for believing that it is so. Hence it is for the electrical engineer, and particularly the central station engineer, to demonstrate that, while costing no more, the system which he advocates possesses substantial advantages over other methods, which it is worth the while of a mill manager to obtain; otherwise, scepticism, prejudice or conservatism, or a combination of the three, may enable the rival system to win the day.

Taking the case where electric power is obtained from an outside source, the chief advantages are:—

(*a*) The breakdown of a motor would only necessitate the shutting down of the particular machines driven by that motor.

(*b*) As the mains are usually laid in duplicate from the power station to the mill, even a breakdown of a main would not affect the running of the mill.

(*c*) Extensions can be made at any time, and, if the full ultimate power required is not needed at the commencement, the capital expenditure on power plant may thus be spread over several years. In some cases this might turn the scale in favour of electric driving, or even result in a financial gain as compared with a competitive system.

(*d*) Abatement of smoke nuisance.

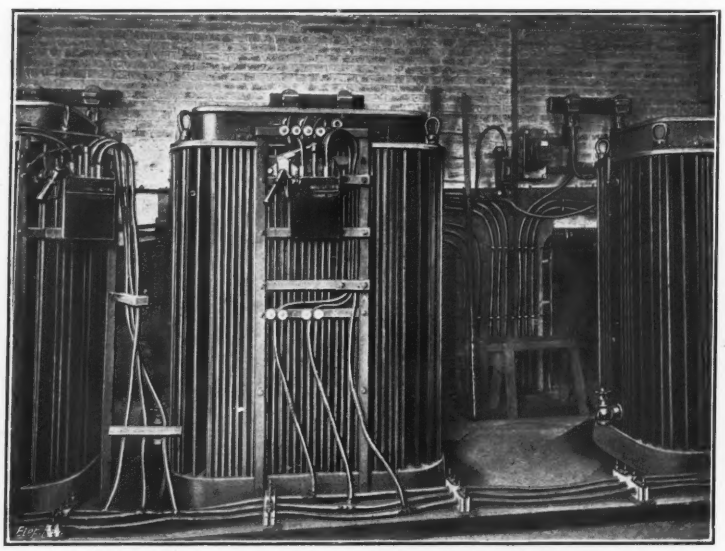


Fig. 4.—Three 500-kw. Three-Phase Transformers.

In the case of (*a*) capital expenditure must be incurred on:—(1) Building and foundations; (2) coal bunkers; (3) boilers; (4) chimney; (5) engine; (6) condensers; (7) condensing reservoirs, or towers; (8) rope race, ropes, &c., while current expenditure will be on: (9) coal; (10) maintenance (wages, oil, &c.); (11) repairs; (12) water; (13) rates, taxes and insurance. In the case of (*b*) very similar items of expenditure will have to be faced amounting probably to about the same as in case (*a*).

Dealing with modern plant in each case, one of the important advantages of the electric drive over the other lies in the fact that a stoppage in one portion of the mill will not affect the remainder, and in the case of this system being adopted in an old mill, it frequently possesses the advantage of lower cost, owing to the facility with which cables may be run and motors put down in out-of-the-way places and isolated sections of the mill, and also to the much lower power losses which take place along electric cables under such conditions, than along steam pipes.

In the case of (*c*), however, the position of affairs is greatly changed, as the capital expenditure will be, comparatively, very small; wages, rates, taxes and insurance will be reduced; oil will be considerably reduced; and the coal item will disappear, all these things being included and paid for as current expenditure in the cost of electricity.

Fig. 5.—10-b.h.p. Motor Driving Bale-breaking Machine Through Belting.

This taken by itself is not likely to receive a moment's consideration, but it is an advantage of real value to the populations of our grimy industrial centres. The amount of smoke emitted from our factory chimneys, even when it does not come "within the meaning of the Act" is a disgrace, and anything which will tend to reduce it should receive some attention at the least.

Most of the electricity supply stations in this country are fairly well equipped for burning coal efficiently, and, therefore, with comparatively little smoke, considering the amount of coal consumed.

(*e*) One portion of the mill may be run overtime, or, as is sometimes done in the process of doubling, a section may be kept running continuously for 24 hours per day.

In neither case does the power bill rise appreciably above the normal for a given production, whereas when power is generated on the premises, the cost in the former case rises to a very high figure, and in the latter case becomes so great as to be prohibitive. Electric driving under these conditions is a decided gain even from a monetary standpoint.

(*f*) In the case of old mills electric driving may easily take the lead on the score of cost, as pointed out earlier in this article.

Having dealt with this subject in general terms, we proceed to describe the Ray Mills installation at Stalybridge (the proprietors of which are the Victor Mill, Ltd.), which has now been running over two years, and was specially built for electric driving, the current being obtained from the Stalybridge generating station.

A general view of the mill is given in fig. 1, from which it will be seen that it may be ranked as a large one; indeed, it is said to be one of the finest mills in the Lancashire district, and to possess the largest cardroom.

The Ray Mill is one of three which have recently combined, the other two being the Victor, erected about six years ago, and the Premier erected about four years ago.

The Victor Mill is driven in the usual way by a steam engine with a rope drive, and it may be remarked that the engine is a highly efficient one of the vertical slow-speed type, and runs very steadily, thus providing a very good comparison with electric driving. Recently extensions have been made at the Victor Mill, and two 100-B.H.P. electric motors have been added as the engine was fully loaded; these two motors are often running when the rest of the mill is idle, and illustrate, in practice, some of the foregoing remarks.

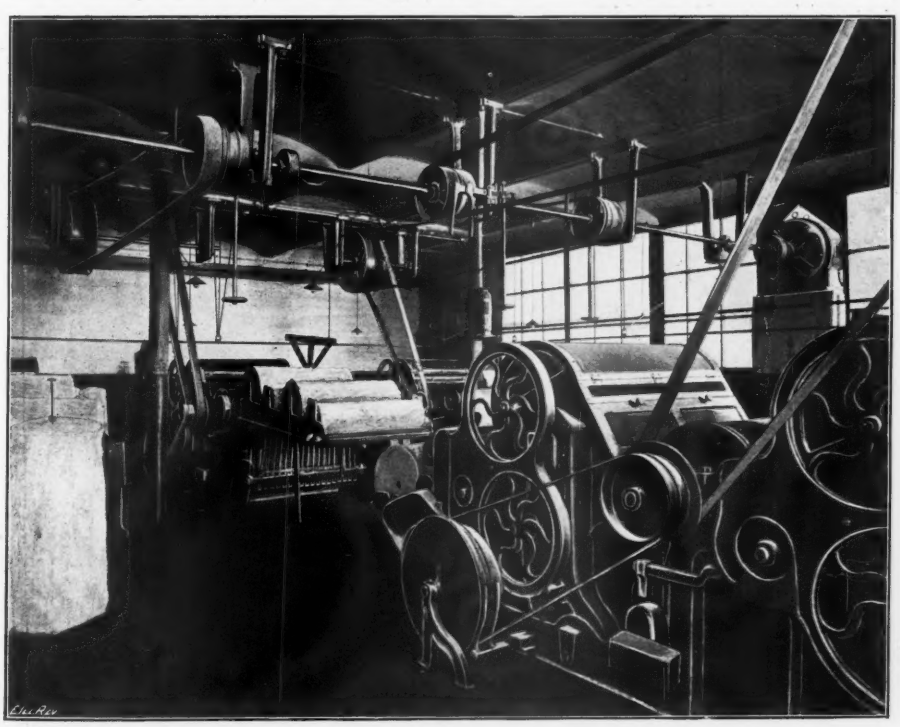


Fig. 6.—Corner of Finishing Room Showing 100-B.H.P. Motor Direct Coupled to Main Shaft.

The Premier Mill is electrically-driven throughout, but as it has already been noticed in our columns, we propose to confine ourselves to the Ray Mills in the present article.

Mill-owners in the Stalybridge district are in the fortunate position of being able to obtain energy from the Stalybridge generating station, where the costs per unit are the lowest in the kingdom, so that it is not to be wondered at that two such first-class mills as the Ray and the Premier are electrically-driven.

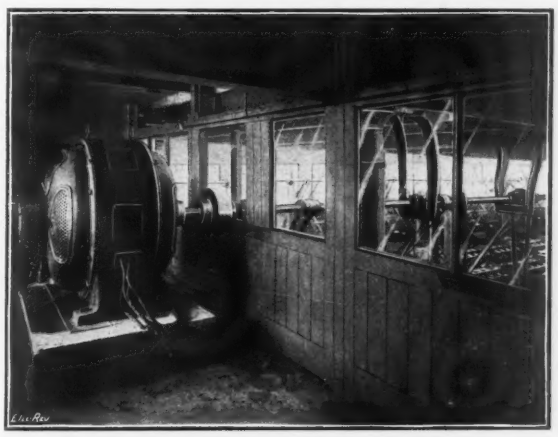


Fig. 7.—100-B.H.P. Motor Direct Coupled to Main Shaft Driving Frames in Card Room.

The Ray Mills having been specially built for electric driving with energy supplied from an outside source, there is no boiler or engine house, no chimney, no condensing reservoir and no rope race. These are replaced by the transformer house and the switch room, which will be seen in illustrations, figs. 3 and 4.

The cables are run in trenches under the floor or are cleated to the walls, and the only space occupied by the electric driving is that taken up by the motors and their switchgear, but this again is very small, a mezzanine floor made off as a compartment of about 17 ft. × 9 ft. serving for a motor of as much as 250 H.P., and this is placed in a direct line with the shafting near the ceiling.

The current supplied to the Ray Mills is three-phase, alternating, of 40 periods per second, and is delivered at 6,000 volts; it is then transformed down to 420 volts for power and 230 volts for lighting.

Current at 420 volts is led from the transformers to the switchboard, whence, after passing through meters belonging to the mill (as a check on the meters put in by the electricity supply undertaking), it goes to the various motors and lighting circuits. The switchboard was supplied by Messrs. Ferranti, and presents a very handsome appearance besides being extremely simple in arrangement.

The motor equipment, which was all supplied by Messrs. Bruce Peebles & Co., comprises the following: Four

250-B.H.P. motors; one 200-B.H.P. motor; one 150-B.H.P. motor; three 100-B.H.P. motors; one 60-B.H.P. motor; two 10-B.H.P. motors; and two 2-B.H.P. motors. The first nine motors are of the slip-ring type, and are furnished with liquid starters; the remainder are of the squirrel-cage type and have auto-transformer starters. The total motor horse-power is, therefore, 1,734, there being 14 motors.

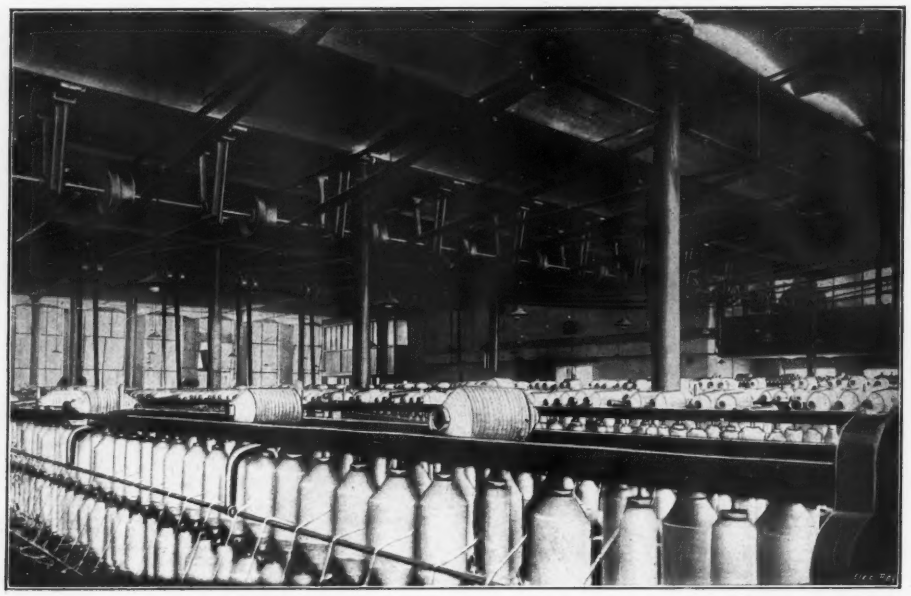


Fig. 9.—Ring Room, showing Main Shafting Direct Coupled to 250-B.H.P. Motor. The Motor can be seen at the Right-Hand End of the Shaft.

The actual demand is at present some 1,600 H.P., but this will be increased soon, owing to additional machinery which is being put down in the doubling room.

The following description gives, in the proper sequence, the operations as carried out in the mill:—

The cotton, as it comes in bales from the cotton fields, passes first through the bale-breaker, which tears it into small pieces for conveyance to the stack mixings. This machine is driven through belting by a 10-B.H.P. squirrel-cage motor running at 800 R.P.M., the starting switch, which is of the auto-transformer type, being fixed on the wall just below the motor, as clearly shown in fig. 5. The cotton is fed on lattices from the mixings, and is next carried on lattice conveyors to the three openers, and thence to the finishing machines, of which there are six.

In all of these processes—bale-breaking, opening and finishing—the cotton is cleared of seed, dirt and dust, and in the last-named process is formed into laps ready for the carding machinery, which, together with the conveyors, is driven by a 100-B.H.P. slip-ring motor running at 800 R.P.M., the starter being of the liquid type (see fig. 6).

From the finishing machines, the laps of cotton are transferred to the carding engines or machines. These are situated on the first floor where, besides 120 revolving flat cards, there are the drawing frames, having nine preparations with 72 finishing deliveries in all, nine slubbers, 18 intermediate frames, and 53 roving machines. One 150-B.H.P. motor drives the cards, and two 100-B.H.P. motors drive the remainder of the machinery in this room; all three motors run at 600 R.P.M., and are provided with liquid starters.

An interesting point about the 150-B.H.P. motor, and one which speaks well for its design and workmanship, is the fact that the load on it is actually 200 H.P., and has been so ever since it was installed two years ago, and we are informed that neither this motor, nor any of the others in the mill, have given any trouble all the time.

Fig. 7 shows one of the three motors just referred to coupled direct on to the main shaft from which the various machines are driven by belting. Fig. 8 gives a better view of the shafting, and some of the machinery thus driven.

After leaving the roving frames, the cotton goes next to the ring frames, and it is here that it is spun into the various *counts* as may be required. The Ray Mills are laid out for spinning single and double roving of what are known as "medium" counts. The second and third floors are devoted to the ring frames, there being 77 frames on each

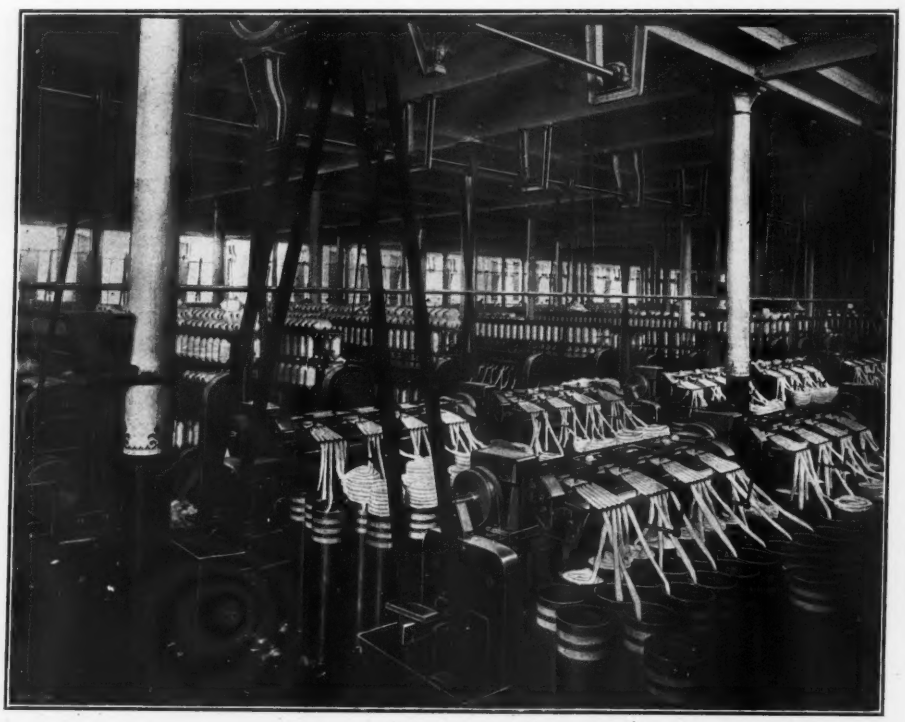


Fig. 8.—View of Drawing Frames, &c., showing Main Shafting Driving Through Belts on to the Machines. The Shaft is Direct Coupled to a 150-B.H.P. Motor.

floor, each frame has 432 spindles, so that there is a total of 66,528 spindles. Four 250-B.H.P. motors are employed in driving these machines, two motors being placed in each room. In this instance, also, the motors are direct coupled on to the main shaft (see fig. 9) whence the frames are driven by belting. We may here remark that, owing to the main shafts running at high speeds (viz., the speeds of the motors) they are considerably smaller in diameter than would be the case if they ran more slowly, and also the bearings and hangers are smaller, this gives lighter overhead construction altogether, and is, of course, cheaper. It is also claimed by some that the mill, if built with the intention of putting in electric drives, can itself be made somewhat lighter in construction, owing to this same fact, and to the greater freedom from vibration, as compared with rope driving.

The fourth floor contains the winding machinery where the finished cotton yarn from the ring frames is wound into ball warps or beam warps as required. A 60-B.H.P. squirrel-cage motor running at 800 R.P.M., coupled by ropes to the main shaft, drives 11 ball warping and 20 beam warping machines.

On the ground floor, in the doubling room, a 200-B.H.P. slip-ring motor running at 600 R.P.M. is arranged to drive 20 doubling frames having 412 spindles each, and seven cheese winding frames with 120 drums each, though only a few of these machines are at present installed.

One of the advantages of an electric drive with energy obtained from an outside source will shortly be very clearly demonstrated in the working of this room, as it is intended to run this machinery 24 hours per day.

Fig. 2 is an illustration of a 2,000-KW. turbo-generator, recently supplied by Messrs. Bruce Peebles to the Stalybridge Electricity Works, which takes its share in supplying energy to the Ray and other mills.

Our thanks are due to Mr. Robert Blackmore, chief engineer of the Stalybridge Electricity Works and consulting engineer to the Ray Mills, Ltd., to Mr. Robert Leach, the managing director of the mill, and to Messrs. Bruce Peebles, through whose courtesy we are enabled to publish the foregoing account of what is undoubtedly a most successful instance of the application of electric driving to textile work.

LIGHTING and POWER NOTES.

(*Concluded from page* 1026.)

Shipley.—The Council's electricity department recently carried out a smart piece of installation work, only some 24 hours elapsing from the signing of the application for a motor outfit, to its being connected up in working order on the consumer's premises.

Sunderland.—At a meeting of the T.C. on the 14th inst., the Electricity and Lighting Committee recommended the adoption of the scheme of revised tariffs, mentioned in last week's ELECTRICAL REVIEW, and the establishment of a sales department in connection with the electricity supply. Alderman Bruce moved the adoption of the report, and referring to the proposed purchase of metal-filament lamps for street lighting, said that, as a result of their use, the energy consumption had gone down very much. At the end of March, 1909, the reduction in revenue was £1,392, and by the end of March, 1910, there was another reduction of £1,245. They did not begrudge this saving to the customers, but they would have to make it up by increased business. Mr. French seconded. Mr. Raine moved that the recommendation be referred back to the Committee for further consideration. With regard to the new tariffs, he could not see how they were going to get an increased revenue in that way. His house was rated on £60, and if they agreed to the new scale, his bill would be slightly more than double. The standing charge on his house would be three times that on a £30 house, and the charge on his father's office would be five times the charge on a £30 house. The scale, instead of inducing trade, would, in his opinion, have the contrary effect. He was also strongly opposed to the Corporation setting up in business in the way it was proposed. Mr. Weir seconded the amendment. He recommended the Corporation to see if it could not sell the undertaking to the Durham County Electric Supply Co. Alderman Bruce hoped that the report would not be sent back. If the scheme were adopted he was prepared to say that they would be able to produce a credit balance. A vote was then taken, and 22 voted for the amendment and the same number against it; the Mayor (Alderman Sanderson) gave his casting vote in favour of the Committee's recommendation.

Tonbridge.—The U.D.C. has received the sanction of the L.G.B. for a loan of £820 for new plant at the electricity works.

Torquay.—Ten firms have agreed to supply fittings for exhibition at the new electrical showroom to be opened by the T.C., free of cost.

Uruguay.—Concessions have been granted to Messrs. Silveira Hermanos for 25 years for electric lighting in Melo, and to Messrs. Carbonell & Co. for 20 years for electric lighting in Trinidad (Uruguay).—*Board of Trade Journal.*

Uttoxeter.—The U.D.C. has referred to a Committee an E.L. scheme submitted by Mr. P. W. Tiddeman, of Stoke-on-Trent. Mr. Tiddeman assures the Council that the scheme will not involve any burden on the rates, but will be a remunerative undertaking.

Warlingham.—The P.C. has asked the Urban Electric Supply Co. to submit terms for public lighting, which is at present done by gas.

West Bromwich.—The T.C. has decided to offer, for the exterior lighting of shops, a fitting containing four 50-C.P. metallic-filament lamps at 13s. per quarter, this payment including the fitting and maintenance of lamps and current for 600 hours per annum. For additional lighting hours the charge is to be 1d. per hour.

The T.C. has received the sanction of the L.G.B. to loans of £4,000 for mains extensions, £5,112 for boosters, switchgear and extensions to generating plant.

Whitby.—The North Riding Education Committee has decided to have the new secondary schools lighted by electricity, which will be supplied by the U.D.C.

TRAMWAY and RAILWAY NOTES.

Barton (near Manchester).—The R.D.C. has decided to dissent from those clauses of the proposed bill to be introduced by the Manchester Corporation, which provide for an extension of time for the construction of tramways at Davyhulme and South Barton.

Continental Notes.—ITALY.—It is intended to introduce electric traction in the near future on the Mont Cenis railway as well as on the Giovi line (Pontedecimo-Bussala), through the Ligurian Apennines. The Italian State Railway authorities have erected, for the working of the Giovi railway, a steam-power station near Genoa, whilst the supply of current for the operation of the Mont Cenis line will be obtained from the Chiomonte hydro-electric works belonging to the city of Turin. Another line between Piemont and Liguria—the Ceva-San Giuseppe-Savona—is to be converted to electric traction, and the 14,000 KW. required for its working will be furnished by the Società Riviera di Ponente R. Negri. A contract has also been concluded between the State Railways and the Adamello Co. for the delivery of 2,000 KW., which is to serve as stand-by for the State Morbegno power station when the Milan-Lecco line, which is a feeder of the Valtellina railway, is electrified in the near future. The Dinamo Co., which furnishes power to the Swiss Federal Railway Administration for the operation of the Simplon railway, is also to supply energy to the Italian State railways for the working of the Varesini lines, when the steam power station at Tornavento, which has high costs owing to the difficulties incidental to the provision of coal, will be shut down. It is also intended to employ electric traction in the south, on the Naples-Avellino railway, as well as on a number of secondary lines closely associated with the Società Italiana A.E.G.-Thomson-Houston.

HUNGARY.—The Buda-Pesth Tramway Co. is about to spend a sum of 545,000 marks on the purchase of 20 new electric cars, the Ministerial confirmation having been obtained.

At Langugest, in Bohemia, and at Wioclawk, in Poland, the establishment of electric tramways is contemplated.—*Elektrotechnik und Maschinenbau.*

HOLLAND.—The Eerste Groningen Tramweg Maatschappij has decided to convert to electric working its horse-drawn service between Suidbrock and Ter Appel, at an estimated cost of 1,500,000 florins, which includes the rebuilding of several bridges.—*Revue Pratique de l'Electricité.*

Dundee.—Important tramway extension proposals are at present before the T.C. Mr. Peter Fisher, the tramway manager, reported to the Tramway Committee that the extension of the Blackness Road route to Glamis Road, a distance of 1,200 yd., including overhead equipment, would cost £4,550. He thought the line would be a great convenience to the increasing population on the route of the proposed extension. It was agreed to recommend the Council to proceed with the extension. Regarding a proposal for an extension at Lochee to the burgh boundary at an estimated cost of £2,640, it was agreed to leave this scheme for a time.

Glossop-Marple.—A project for the construction of about 5½ miles of tramway from Glossop to Marple Bridge is under consideration. The route proposed is through Charlesworth, Chisworth and Cornstall Road.

Greenock.—The Law and Parliamentary Committee of the T.C. has decided to apply for the sanction of the Secretary for Scotland to an increase of £22,000 in the borrowing powers of the Corporation, in order to carry out the scheme of extension at the local electricity works. The scheme includes the extension of the present buildings and the installation of two large boilers and a steam turbo-generator.

Halesowen.—At the monthly meeting of the U.D.C. last week an important report was submitted respecting the proposed light railway, over which there has been considerable correspondence for some time. The Light Railway Committee of the Council reported that on November 9th a letter was received from the Parliamentary agent for the Light Railways Order stating that the Commissioners adjourned a local inquiry to enable the Birmingham Corporation to submit a clause for insertion in the Order to the Commissioners and the promoters. After considerable delay the Corporation intimated to the Commissioners that there were difficulties in adjusting a satisfactory clause, and proposed that it should be allowed to deposit a draft order authorising the Birmingham Corporation to construct Railway No. 5. The Commissioners agreed to this, subject to the insertion of clauses for the protection of the Halesowen undertaking. The Birmingham Corporation then deposited an order, but without any clause for the protection of the undertaking. The Commissioners were then applied to for facilities to the promoters of the Halesowen Order to appeal to the B. of T. against the decision of the Commissioners, and after considerable correspondence and delay the Commissioners decided, as the promoters of the Halesowen Order were not prepared to assent to the promotion by the Corporation of their Order, that the Order could not be proceeded with, but that the Halesowen Order might be proceeded with except insofar as it sought to authorise Railway No. 5. The Committee recommended that the clerk should write to the Light Railway Commissioners therefore, pressing them to grant Railway No. 5 to the Halesowen Light Railway Co.—Mr. Hadley moved the adoption of the Committee's report, and expressed the hope that the Council would do everything possible to support the efforts of the Halesowen Light Railway Co.—The clerk (Mr. E. H. Grove) said that the Committee had submitted a fresh application to the Commissioners, which provided for an altered scheme, and which would not allow any opposition from Birmingham. He added that he had received objections to the scheme from the Smethwick T.C., and the Oldbury U.D.C.—Mr. Hadley said the delay in carrying out the work was due to the interference of outsiders.—The report was adopted, and it was decided to support the Halesowen Light Railway Co. in its efforts to carry out the scheme.

Handsworth.—The U.D.C. has given instructions for plans, sections and specifications to be prepared for the re-construction of part of the cable tramway and conversion to electric traction on the overhead system

Hindley.—The U.D.C. has resolved to dissent to the proposed Bill to be promoted by the South Lancashire Tramways Co. in the next session of Parliament.

Llandudno.—At the monthly meeting of the D.C., the chairman (Mr. E. Bone) said that he and the clerk recently met a director of the Electric Tramway Co., upon whom they urged the importance of the penny fare for bringing passengers into the heart of the town from Craigydon and from West Shore. The Council had before it an application from another company for licences for motor-'buses, on which more satisfactory penny stages would be provided. Something of that kind, he said, would bring about a change in the attitude of the Electric Tramway Co. more quickly than moral suasion. The clerk read a letter from the B. of T. enclosing a communication received by the Board from the Electric Tramway Co., suggesting that the new penny stages had the approval of the Council. The chairman said that was incorrect, as the two stages he had mentioned did not meet with the approval of the Council. It was decided that a communication to this effect be forwarded to the B. of T.

London.—L.C.C.—In connection with the tramways plant, it has become necessary to install new H.T. switchgear in place of existing gear at the Camberwell and New Cross sub-stations, this gear being some of the earliest installed, which does not comply with the recent regulations of the Factory and Workshops Act. The Highways Committee puts forward an estimate of £5,000 for the work, which cost will be charged to renewals. New switchgear and alterations to existing H.T. switchgear for controlling the cables between Holborn and Elephant and Castle sub-stations are proposed at a cost of £500, and other switchgear for electric lighting at the Wandsworth and New Cross car-sheds, the Kingsway subway and the tramway offices in Belvedere Road, the estimated cost amounting to £4,500. The Finance Committee, in reporting on the above, comments on the fact that plant installed so recently as 1903 is now out of date, when less than one-third of the period of repayment has expired.

The Council has agreed to pay £309 to the Brighton Railway Co., and £57 costs, which constitutes the award of the arbitrator in connection with the railway company's complaints as to the interference with its signalling arrangements by the Council's tramways at Tulse Hill and Norwood.

Morecambe.—The directors of the Morecambe Tramways Co. propose to substitute motor for horse traction on the company's system. The Bill authorising the change has received the Royal Assent.

Manchester.—The question of eight hours a day for Manchester tramway men was under consideration by the Tramways Committee on Tuesday. For some time the men have been agitating for a limitation of their working day to eight hours, and not only have representations been made to the Committee, but the City Council has discussed the matter. The Committee, however, has always opposed alteration on the ground that if an eight-hour day were given to the men, the Committee could not hand over to the relief of the city rates the large amount it is in the habit of contributing. The Workmen Committee of the Corporation on Tuesday afternoon further considered the question of granting an eight-hour day to Corporation employés, and endorsed the recent decision of the Council against granting the concession.

Nottingham.—The Corporation electric tramways now link up every portion of the city, the latest addition to the system—the Carlton Road route—being now in public use. The new section caters for the Sneinton district, the most densely populated of the city's suburbs, and meets a long-felt want. The formal inspection by the B. of T. Inspector took place on Friday morning, and the public service commenced in the afternoon.

Oxford.—According to the *Light Railway and Tramway Journal*, the electrification of the tramways is postponed indefinitely, as little hope is entertained as to the profitable conversion of the line into a part-trolley and part-conduit system, as provided for by the Act.

Quarry Bank.—The B. of T. has extended until June next the period for carrying out the Light Railway Order for the construction of tramways in the Quarry Bank, Brierley Hill and Rowley Regis districts.

Rawtenstall.—At the monthly meeting of the T.C. on the 15th inst., the electrical engineer reported as to the progress of the electrical portion of the new tramway along the Whitewell Valley, submitting cable certificates from Messrs. W. T. Glover and Co. and a letter from Messrs. Clough, Smith & Co. stating that the whole of the works comprised in their contract had now been completed. It was resolved that the construction of the permanent way be proceeded with, and that a special sub-Committee be appointed to fix a suitable date for the opening of the new tramway, and for the inspection of the B. of T.

Scarborough.—Mr. Gripper and Dr. Dale (directors), with Mr. W. E. Nicholl (secretary and manager), representing the Scarborough Tramways Co., waited upon representatives of the T.C. on Tuesday night, when a conference took place on the deadlock with regard to the running of a winter service. The Corporation had previously declined to make up any loss sustained by the Tramways Co. by the running of a winter service. Amongst other matters of detail discussed at this conference, the representatives of the company asked that the Corporation should relieve the latter of the maintenance of certain portions of the track. The Corporation representatives did not give much hope that the request would be entertained, and they will submit a report upon the conference to a meeting of the Streets and Buildings Committee, which consists of all the members of the Council.

The T.C., in committee, has decided to proceed against the Tramways Co. for non-compliance with the B. of T. orders to run a limited service of cars during the winter. Under the terms of the Scarborough Act the company is liable for a penalty of £5 for each day on which the cars are not running.

South Bank.—The U.D.C. has decided, in order to protect its own interests, formally to dissent to the application of the Imperial Tramway Co. for an extension of time for extending the tramways in the district.

Sutton-in-Ashfield.—The promoters of the Notts. and Derbyshire Tramways Order, 1893, have applied for permission to abandon certain portions of the scheme, and for an extension of time for carrying out other portions.

U.S.A.—Somewhat of a novelty in its way is the decision of a Pennsylvania inter-urban traction system to establish a height limit in place of the usual age limit for determining children's fares. According to *Electric Traction Weekly*, this company has had a gauge line painted round the interior of the car at a height of 45 in. above the floor; in case of dispute the youngster "heads" the line, and if taller than 45 in. he pays full fare. Our contemporary considers that this is a much fairer proposition than the age limit, because the cost of handling a person is dependent upon size and space occupied, and height is a better index as to weight than age, even if it were possible to verify the latter.

An accident of an extraordinary and disastrous character, resulting in the death of nine persons and injuries to over 200 others, was caused by an explosion at the New York Central Railway's power house in Fiftieth Street and Park Avenue. It is reported that during the charging of the storage cylinders on a train with Pintsch gas, the feed pipe broke and the escaping gas became ignited by sparks from an adjacent live rail; a dynamite explosion followed, and this wrecked a number of boilers in the power house, and demolished the building itself. A passing tramcar and other vehicles were wrecked, and buildings within half a mile radius were more or less severely damaged.

TELEGRAPH and TELEPHONE NOTES.

Atlantic Cable Amalgamation.—The persistent rumours regarding the formation of an Atlantic Cable Trust came to a head last week-end, when the chairman of the Executive Committee of the Western Union Cable Co., Mr. E. T. Hall, on the eve of returning to the United States, announced that arrangements had been completed according to which the affairs of the Western Union Co. and of the Anglo-American Cable Co. would in future be conducted under common management. The result of this amalgamation is to give the Western Union Co. control over seven out of sixteen existing Atlantic cables. Mr. Hall also stated that the P.M.G. had agreed to the proposition to charge half-rates for messages in plain language, and had granted landing rights for the Western Union's new cable.

Mr. C. H. Mackay, president of the Commercial Cable Co., which has five cables, on learning the news, said that his company was now the sole competitor with the associated companies, and that it would not enter into any combination.

An official has stated that no actual amalgamation has taken place—only a working agreement. Nevertheless, it seems clear that all the Atlantic cables landing in this country are now under American control. The Western Union Co. has guaranteed in perpetuity the payment of 3½ per cent. on the capital (£7,000,000) of the Anglo-American company.

Cables Broken.—As the result of an earthquake in the sea south of Zanzibar, four of the Eastern Telegraph Co.'s cables between that island and Durban were broken on December 13th.

Cape Town.—The Union Government has decided to erect a wireless telegraph station in the Cape Peninsula. The site selected is at Slangkop, near Kommetje. A contract has been entered into with the Marconi Co. and it is expected that the station will be in working order in a few months. It will be a 5-KW. station and will have a day range of 400 miles, while at night the range will be from 600 to 1,600 miles.

Siberia.—A system of wireless telegraphy has just been established between Nikolaiefsk and Petropavlovsk in Kamschatka.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 4th, 1911. Three multiple switchboards, for the P.M.G.'s Department in New South Wales. See "Official Notices" November 4th.

January 4th, 1911.—Iron poles, ironwork, and switchboards, for the P.M.G.'s Department in Queensland. See "Official Notices" November 18th.

January 10th, 1911.—Telephone cable, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 10th, 1911.—Contacts and condensers, for the P.M.G.'s Department in Victoria. See "Official Notices" November 18th.

January 24th, 1911.—Wire, twisted pair, for the P.M.G.'s Department in Victoria. See "Official Notices" December 2nd.

January 25th, 1911.—Portable petrol-driven winch, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 2nd.

January 25th, 1911.—Insulators, wire, &c., for the P.M.G.'s Department in South Australia. See "Official Notices" Dec. 2nd.

February 1st, 1911.—Testing equipment, for the P.M.G.'s Department in New South Wales. See "Official Notices" December 9th.

February 7th, 1911.—250 indicators, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 7th, 1911.—Eleven sections of a branching multiple magneto lamp-signalling switchboard, for the P.M.G.'s Department in Victoria. See "Official Notices" December 16th.

March 14th, 1911.—Installation of wireless telegraphy at Thursday Island and Papua, for the P.M.G. of Australia. See "Official Notices" to-day.

April 18th, 1911.—One common-battery switchboard, for the P.M.G.'s Department in Western Australia. See "Official Notices" to-day.

MELBOURNE.—February 22nd, 1911. 2,000 steel tramway plates. Specification, conditions, &c., at the City Surveyor's office, Town Hall.

SYDNEY.—January 23rd. Two 750-KW. units for Newtown sub-station for the Government Railways. Particulars at Electrical Engineer's Office, 61, Hunter Street, Sydney, N.S.W.

WESTERN AUSTRALIA.—February 28th. Electrical pumping machinery for the Minister of Public Works. Conditions, &c. (one guinea) from the Contractors' Room, Public Works Office, Perth.

Belgium.—January 4th. The Belgian Post and Telegraph authorities at La Bourse, Brussels are inviting tenders for the supply and fixing of a large quantity of telephone cables in the Liége district.

December 27th.—Tenders for the supply and fixing of the overhead equipment of electric tramways in Brussels are invited by the Société Nationale des Chemins de fer Vicinaux, of Brussels.—*Elek. and Masch.*

Bury.—January 4th, 1911. For supply and erection of following materials in connection with Chamber Hall Power Station, viz:—(*a*) Steel steam pipes, valves and accessories, (*b*) cast-iron pipes, valves and accessories. Specifications and forms of tender from S. J. Watson, electricity works, Bury; deposit, £1 1s. (returnable).

Cape Town.—March 1st, 1911. Tenders are invited for the installation of a system of ventilation, heating and cooling in the new Law Courts. Information from the architects, Messrs. Hawke & McKinlay, Rhodes Buildings, Cape Town, and the High Commissioner of the Union of South Africa, 73, Victoria Street, London. Tender to the Controller and Auditor-General, Parliament Street, Cape Town.

Carlisle.—December 27th. Supplying and laying and jointing 600 yards ·25 concentric paper-insulated and lead-covered cable, for the Corporation. See "Official Notices" to-day.

Denmark.—January 16th, 1911. One 4,000-KW. turbo-generator, with condensing plant, for the municipality of Copenhagen. See "Official Notices" to-day.

East Ham.—December 30th. One 1,000-KW. triple-expansion medium-speed steam engine and generator, and one evaporative condenser, with air and circulating pumps, piping, &c., for the Corporation. See "Official Notices" December 9th.

Haslingden.—The new Infirmary being erected by the Haslingden Guardians is to be illuminated by electricity, and on December 15th it was decided to take steps to secure tenders.

Leek.—The U.D.C. has instructed the surveyor and electrical engineer to the prepare plans and obtain tenders for a cooling tower and tank for circulating water.

Leytonstone.—December 30th. Electric lighting installation at the new County High School, Forest Road, for the Essex Education Committee. See "Official Notices" December 9th.

Llandudno.—December 24th. (*a*) Motor-driven induced-draught plant, (*b*) mechanical stokers for one Lancashire and one Babcock boiler, for the U.D.C. See "Official Notices" Dec. 9th.

London.—ISLINGTON.—January 12th, 1911. High-tension switchboard for the Borough Council Electricity Works. See "Official Notices" November 25th.

January 10th, 1911.—High and low-tension switchgear. See "Official Notices" December 9th.

HACKNEY.—January 4th. Installations of telephones in Pavilions A and B, at the Infirmary, High Street, Homerton, and removal of existing installation in Pavilion A, for the B. of G. See "Official Notices" December 16th.

Manchester.—January 9th. The Tramways Committee invites tenders for special (permanent way) trackwork.

Portuguese West Africa.—March 25th, 1911. The municipal authorities of San Thomé, Portuguese West Africa, are inviting tenders for the concession for the establishment of a central generating station for the supply of electrical energy for lighting and power purposes in the town.

Salford.—January 16th. Steam-driven air-lift pumping plant, for the Corporation electricity works. See "Official Notices" December 16th.

Shanghai.—January 4th, 1911. Two turbo-alternators, 2,000 to 2,500 KW., with condensing plant, and four water-tube boilers, with integral superheaters, mechanical stokers, economisers, &c., for the Municipal Council. See "Official Notices" Dec. 9th.

Sheffield.—December 30th. Building work for extension to Neepsend power station, for the Corporation. See "Official Notices" December 16th.

Shotley Bridge.—January 9th, 1911. Two high-speed engines and generators, switchboard, battery, and wiring for about 500 lights, at the new buildings on Whinney House Estate, for the Gateshead B. of G. See "Official Notices" to-day.

Spain.—Tenders have just been invited by the municipal authorities of Socuellamos (province of Ciudad Real) for the concession for the electric lighting of the town during a period of 15 years.

Taunton.—2,500-volt single-pole switches and fuses, for the Corporation. See "Official Notices" to-day.

Todmorden.—January 11th, 1911. Wiring and fittings for the Town Hall, including conversion of gas chandeliers, for the Corporation. See "Official Notices" to-day.

Turkey.—March 14th. H.M. Consul-General at Constantinople (Mr. H. C. A. Eyres) reports that the Turkish Ministry of Public Works invite tenders for a concession for the construction

and working of electric tramways in Adana, and for a concession for the distribution of electrical energy in the vilayet of Adana. The concessionaire will have the right to erect hydro-electric works on the banks of the upper Seïboun Tchaï river. Tenders to be addressed to "Monsieur le Ministre du Commerce et des Travaux Publics," Constantinople, from whom the conditions, &c., can be obtained on payment of 9s.

Local representation is essential in the case of Turkish Government contracts. A list of British commission agents established in Constantinople may be obtained by British firms on application to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.—*B. of T. Journal.*

CLOSED.

Bolton.—The Tramways Committee has accepted the following tenders:—

Messrs. T. W. Ward.—For old rails.
Mr. John Clarkson.—For scrap steel.
Messrs. W. A. Musgrave.—For scrap copper and brass.

The Watch Committee has accepted the tender of Messrs. T. Francis & Son for electrical fittings for the Fire Brigade Department.

The Electricity Committee has accepted the tender of Messrs. Musgrave & Son for a dome in connection with the condensing plant at the electricity works, and the tender of Messrs. W. H. Allen & Co., Ltd., for a pump.

Colwyn Bay.—The U.D.C. has accepted the tender of Mr. Bertram Thomas, of Manchester, for switchgear at the electricity works, at £84.

Dewsbury.—The Building Committee of the Dewsbury and District Infirmary Board has accepted the tender of Mr. Foggo, Dewsbury, for the electric lighting of the new extension and the supply of two fans.

Glasgow.—Messrs. Brown & Young, of Glasgow, have secured the contract for the lighting of the Day-workers' Block at Ruchill Hospital, their offer being £57.

Government Contracts.—The following tenders have been accepted during the past month by the Government departments named:—

WAR OFFICE.

Works services, installation of electric light, Deepcut.—G. E. Taylor & Co.

INDIA OFFICE STORES DEPARTMENT.

Cells.—Siemens Bros. & Co.
Dynamo.—General Electric Co.
Meters.—Lancashire Dynamo, &c., Co.
Sounders.—British Insulated and Helsby Cables, Ltd.

CROWN AGENTS FOR THE COLONIES.

Boilers.—Babcock & Wilcox, Ltd.

GENERAL POST OFFICE.

Telegraphic apparatus.—Gell Telegraphic Appliances Syndicate, Ltd.
Core paper cable.—Callender's Cable and Construction Co., Ltd.; Johnson and Phillips, Ltd.
Retardation coils.—Western Electric Co., Ltd.
Flexible cords.—British Insulated and Helsby Cables, Ltd.
Insulators.—Bullers, Ltd.; Doulton & Co., Ltd.; Taylor, Tunnicliff and Co., Ltd.
Telegraph paper.—Colley's Patents, Ltd.; Waterlow & Sons, Ltd.
Lightning protectors.—Siemens Bros. & Co., Ltd.
Bell receivers.—British Insulated and Helsby Cables, Ltd.
Telephone bell sets.—British Insulated and Helsby Cables, Ltd.; International Electric Co.
Equipment local telephone exchange, Cubie Street, Glasgow.—Western Electric Co., Ltd.
Shuttle Street, Glasgow.—Western Electric Co., Ltd.
Sutton, Surrey.—Western Electric Co., Ltd.
Prince Edward Street, Crosshill, Glasgow.—Western Electric Co., Ltd.

OFFICE OF WORKS.

Carbons for arc lamps.—General Electric Co., Ltd.

Leek.—The Lighting Committee has accepted the tender of Messrs. Lambert Bros., of Walsall, for tubes and fittings for 1911.

London.—L.C.C.—The Fire Brigade Committee received the following tenders for charging apparatus at the new fire stations erecting at Bow and Bromley-by-Bow, for the electrically-driven motor (escape) vans:—

Electric Construction Co., Ltd.	(recommended) £260
Lancashire Dynamo and Motor Co., Ltd.	281
General Electric Co., Ltd.	293
Wright & Wood, Ltd.	304

Rawtenstall.—The T.C. has accepted the tender of the executors of Joseph Birtwistle, of Waterfoot, for installing the electric light at the refuse destructor, lamp department, storerooms, offices, stables and horsekeeper's house, &c., at the central depôt, and the stables, offices, fire station, &c., at the Clarkeholme depôt.

Sunderland.—The T.C., on 14th inst., accepted the following tenders:—

Siemens Bros.—800 metallic-filament lamps for street lighting.
Messrs. Feranti.—Oil break switch for turbo-generator.

Whitehaven.—The T.C. has accepted the tender of Messrs. David Burns & Co., of Whitehaven, for the installation of the electric light at the hospital.

FORTHCOMING EVENTS.

Royal Institution.—Thursday, December 29th. At 3 p.m. Lecture, adapted to a juvenile auditory, on "Sound: Musical and Non-Musical," by Prof. S. P. Thompson. (Lecture I, "Production of Sound.")

Saturday, December 31st. At 3 p.m. Lecture on "Sound," by Prof. S. P. Thompson. (Lecture II, "Transmission of Sound.")

Association of Mining Electrical Engineers (South Wales Branch).—Saturday, December 31st. At 3.30 p.m. At the Hotel Metropole, Swansea. Resumption of discussion on "The Inspection and Repair of Electrical Plant Underground."

NOTES.

The Compliments of the Season!—Ordinarily, by the dictates of the calendar, we defer our retrospections until the festive spirit of the Christmastide has fled. We may, however, be permitted to remember, as aiding the proper mood of the moment, that the Christmas of 1910 comes as a crowning-point of a very satisfactory 12 months enjoyed by many connected with the electrical trade. Surely to these we may wish "A Very Merry Christmas"! To those who, in special departments, have not booked all the business they expected to receive—well, surely, too, we may wish these to have a merry Christmas as a compensation, forgetting, for a few days at least, that there are such evil influences as cut prices and foreign competition in the world. For the general rank-and-file who have been engaged in steady, continuous, conscientious work, professional and industrial, connected with electrical engineering affairs—these are as likely as any to have an enjoyable season, because they have not the same personal anxiety as the two preceding classes. These lines are not in time to reach our foreign readers with a word of Christmas cheer from their friends at Home, but the ELECTRICAL REVIEW wishes all of its supporters in foreign parts one of the happiest and most prosperous new years in 1911.

Electrical Fatalities.—The Manchester City Coroner on Monday held an inquiry into the cause of the death of Harry Wood (20), of Brook Street, Hulme Hall Lane, Miles Platting, a sub-station assistant in the employ of the Manchester Corporation Electricity Department, who died in Ancoats Hospital on Saturday as the result of burns. Wood on Sunday, December 11th, was sent to clean an electrical machine at the Metropolitan Amalgamated Carriage and Wagon Co.'s works in Ashton Old Road, and shortly afterwards he was observed staggering towards the lodge with nearly all his clothing burnt off, and suffering very severely from burns. It was afterwards found that a high-tension switchboard in the power house had been touched, though Wood had received definite instructions not to interfere with that portion of the apparatus. In evidence it was stated that Wood had no right to meddle with either the high or low-tension switchboards, but for some reason or other he had removed the cover of the high-tension board where there was a voltage of 6,500. He must have touched this and got the full shock, for besides burning the man one of the cables had been burnt away. Mr. Bolton, the superintendent engineer to the Corporation electricity department, stated that to remove the cover of the high-tension switchboard Wood had used a key. The key was secreted in the telephone box in the power house, and how he ascertained that it was there no one knew. In any case the deceased was acting against instructions. A verdict of "Accidental Death" was returned.

The death occurred on Sunday, at Ossett, Yorkshire, of Sydney Henshall, an electrician, who for the past 16 months has been employed at the Ossett electricity sub-station near Leeds. He had been engaged in cleaning dynamos (10,000 and 20,000 volts), when he received a shock, and death took place almost instantly. He was 21 years of age, and had written a letter on Saturday night for his parents in Oldham, telling them he would be home at Christmas, and he intended posting it after he had finished work. Deceased was employed by the Yorkshire Electric Power Co.

An inquest was held at Grassmoor on December 13th into the cause of death of Frederick Toseland (30), a motorman at the Bond's Main Colliery. A labourer (David Naylor) at the colliery said that deceased, who worked with him, said that he was going to oil up. He then turned his eyes towards the switch, which he generally did, and climbed up on to the platform of the motor. Suddenly witness heard him cry "Oh!" and, looking up, saw Toseland clinging to the naked wires, with his feet still on the platform. He went up to Toseland, and was about to pull him off the wires, but the current threw him back, and had witness not quickly caught hold of some iron girders he would have tumbled down. He then shouted to another man, and as soon as the power was turned off, Toseland fell back into witness's arms. In reply to questions by the Coroner, witness (according to the report in the *Sheffield Daily Telegraph*) said he noticed that when Toseland climbed up, the switch was in a vertical position, and thus there should not have been any power on the wires. Thomas John Evans, slack washer at the colliery, said that the switch at the time of the occurrence was off and the motor was standing. He could not account for the power in the wires. He tried artificial respiration for half an hour, without avail. Walter E. Chappell, electrical engineer to the Staveley Coal and Iron Co.,

said that if the switch had been in a vertical position, as stated, no current could possibly have passed through the wires. The only feasible explanation he could give was that the switch had been slightly touched, and so caused the current to pass through the wires. Dr. O'Farrell said the cause of death was heart failure, and this might have been brought about from a sudden electric current passing through the system. Dr. Godwin Chase, who had made a post-mortem examination, said there was considerable disease of both lungs. The cause of death was failure of the right side of the heart, which might possibly be attributed to the passage of an electric current through the body. On the other hand, it might have been caused otherwise. At all events, Toseland must have had a sudden strain on his heart. The Coroner said the evidence was most conflicting. It seemed to him the only interpretation to be put on the evidence was that the switch could not possibly have been straight, but was a couple of inches or so out of the vertical. There was, without doubt, a current passing through the wires. The verdict stated that death was due to "Shock caused by the accidental passage of electricity through the body."

Late Legal.—La Radiant Co., Ltd.—In the Chancery Division on Wednesday, December 21st, Mr. Justice Eve had before him a motion in *re* La Radiant Co., Ltd., Cousin *v.* The Company. Mr. R. J. Woodfin said he appeared for the plaintiff, a debenture-holder, and he asked for the appointment of a receiver and manager. The amount of the debenture was due. The company were carrying on an electric oven business at Montimer Street, London, receiving orders and passing them on to makers. There was a considerable number of goods on the premises, and it was essential for the preservation of the debenture-holders' security that a receiver and manager should be appointed. Counsel proposed the appointment of Mr. Philip E. Farr. His Lordship granted the application, appointing Mr. Farr receiver and manager with liberty to act at once, but not to continue to act as manager after January 31st next without the sanction of the Court.

Copper.—Messrs. Merton's circular for mid-December shows a further reduction of 1,291 tons in the visible supplies, which is at a lower rate of withdrawal than has prevailed since February, the average being a decrease of 3,000 tons per month. In this case the increase in quantity afloat from Australia (450 tons) is more than balanced by the decrease in that from Chile. Supplies from North America to England are up, registering 6,235 tons to English ports and Havre, and 6,203 tons to the rest of Europe. The average to the former for the past 12 months has been only 6,813 tons per month, the rest of Europe taking 17,400 tons per month. Spain and Portugal are low with 508 tons; and both Chilian and Australian shipments are below the average. Deliveries, at 18,612 tons, do not indicate a high figure for the whole month. American visible supplies for November 30th stood at 58,210 tons, a reduction of 3,960 tons on the preceding month. The average reduction since July has been 4,492 tons per month.

Institution and Lecture Notes.—Institution of Post Office Electrical Engineers (Metropolitan Centre).—At a meeting of this Centre, held on Monday, 12th inst., at the Northampton Institute, Clerkenwell, Mr. J. G. Lucas, of the Headquarters Staff, gave a paper dealing with the result of some extensive investigations which had been carried out in practice and under laboratory conditions in connection with the ordinary types of signalling batteries used by the British Post-Office and other telephone administrations.

In dealing with the porous-pot Leclanché type of cell, Mr. Lucas showed that the text-books were very much out of date on this question, and that modern telephone requirements could be met much more economically by modifying the sub-division of the manganese dioxide and carbon in the porous pots. In the case of even such small current-discharge rates as 40 milliamperes, the result of the modifications was shown to decrease the total working costs by not less than seven times; whilst at discharge rates higher than 40 milliamperes, the decrease in costs was shown to be much greater. The agglomerate form of Leclanché battery, Mr. Lucas pointed out, was an expensive type, and the possible advantages which may be derived by its use were not commensurate with this expense.

In connection with the use of dry cells as at present designed, the investigations went to show that the chief difficulties and expense lay in the fact that, for discharges which must necessarily be spread over several months, the full use could not be made of the chemical energy vested in the materials used in these cells, owing to the sudden rise, after a time, in the internal resistance. Details were given of experimental cells, the behaviour of which indicated that the difficulties were not insuperable.

As the free ammonia gas evolved from Leclanché cells is found to seriously affect the metal work of telephones and to act deleteriously upon secondary cells, Mr. Lucas gave details of satisfactory experiments which had been conducted with an electrolyte of manganese chloride instead of the usual ammonium chloride solution. He pointed out the practicability of sealing up the battery compartments in connection with cells charged with manganese chloride solutions, and the consequent reduction in loss by evaporation as compared with ammonium chloride solutions.

In comparing the costs and efficiencies of the various batteries for subscribers' speaking purposes, Mr. Lucas stated that even experts in determining telephone transmission efficiencies were unable to perceive any loss due to the resistance of the usual two-cell speaking battery rising from ·5 ohm to 4 ohms, and that even at 6 ohms internal resistance, the loss was only just appreciable to experts. This, he pointed out, had an extremely important bearing upon the question of the most economical type of battery to be used for subscribers' speaking sets, and he gave information relating to a modified type which would apparently result in the total working costs being reduced to half as compared with the existing agglomerate battery, and nearly to one-third as compared with dry cells.

Physical Society of London.—The annual exhibition duly took place on Tuesday last, with the usual success; particulars will be given in our later issues.

Society of Engineers (Inc.).—The first annual general meeting was held on December 12th, when the result of the postal ballot for the election of council and officers was announced. The president for 1911 is Mr. F. G. Bloyd. The report of the Council showed that the amalgamation of the two societies had been fully justified by the success of the first year's work, and gave details of the work accomplished and in progress.

Institution of Electrical Engineers (Yorkshire Local Section).—A reception was held by the Chairman of this Section, Mr. T. Harding Churton, followed by a smoking concert, at the Hotel Metropole, Leeds, on December 13th. There was a good attendance of members and their friends, and an excellent programme of vocal and instrumental music was greatly enjoyed. Mr. Kitchen's orchestra played the march "Pomp and Circumstance" and the Morceau "Salut d'Amour" (Elgar), the graceful dance "Henry VIII," (Sullivan), selection from "Merrie England" (Ed. German); violin solos by Tenaglia, Beethoven, Gossec-Moffatt, Saint-Saens, Porpora, and Paganini were contributed in masterly style by Mr. Montagu-Nathan, while Messrs. R. Wilson, S. H. Smith and W. E. Lang sang a number of songs, which completed a most enjoyable entertainment. At the conclusion of the concert, a hearty vote of thanks to the Chairman, proposed by Mr. Wilson Hartnell and seconded by Mr. W. M. Rogerson, was carried with acclamation.

Proposed Manufacture of Cables in Australia.—A correspondent sends us the following interesting cutting from an Australian newspaper:—

"Melbourne, Tuesday.

"A company intends starting the manufacture in Australia of cables, wire, and other material used by the Telegraph Department. To-day a representative of Messrs. Kirk & Lorentzen, engineers, of Sydney, waited upon the Minister for Customs to ascertain what the Government would be prepared to do to encourage the industry. They suggested that action might be taken in the direction of more tariff protection or a bonus being offered. Mr. Tudor said he was pleased to hear that there was a prospect of a new industry being started in Australia. Before making any definite reply regarding the attitude of the Government, he would like to have some details of the number of men likely to be employed, what the output would be, the extent of the market, &c."

Car-Shed Politics.—During the recent Parliamentary Election at Reading, the Prime Minister addressed a monster meeting in the tramway car-sheds in support of the Attorney-General, Sir Rufus Isaacs, K.C., and two days later Mr. Balfour spoke in the same building to another huge audience. It was estimated that about 20,000 persons were present at the two meetings.

The Little Hulton Mine Disaster.—We are quite sure that every one will at such a moment as this be feeling the deepest possible sympathy with the relatives of the 300 and more entombed—apparently hopelessly—miners in the Little Hulton Colliery. Equally sure are we also that electrical men will be glad to find it placed on record—even in the daily Press—that the cause of the terrible disaster cannot be attributed to electricity, as, in the words of the *Times*, "there had been no shot-firing, and there was no electric cable in the pit."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. W. T. Le Feuvre, borough electrical engineer, Bexhill, who met with a bad accident while training as a Territorial Engineer officer at Chatham some months ago, has now been able to leave the Royal Herbert Hospital, Woolwich, and return to Bexhill. It is hoped that he will be able to get about early in the new year.

The staff and employés of the Folkestone Electricity Supply Co. have presented three trunks to Mr. Ben. Hesketh, chief assistant at the works, who is taking up the appointment of assistant engineer to the River Plate Electricity Co., Argentine Republic.

On resigning the position of manager of the gas and electricity department of the Stafford T.C., Mr. H. Pooley has been presented by the staff and employés with a case of cutlery.

The Lowestoft E.L. Committee, after considering the application of the electrical engineer for an increase of salary from £250 per annum, has recommended that he be paid 5 per cent. upon the profit of £650 for the past year.

Mr. C. Sheppard, mains superintendent for the Windsor Electrical Installation Co., who is leaving to take up a position at Hertford, has been presented by his colleagues with a piece of silver plate.

Tramway Officials.—According to a Bristol paper, the directors of the Bristol Tramways and Carriage Co. have appointed Mr. W. H. Munton, who for the past 10 years has held the position of outdoor electrical engineer, as assistant manager, in place of Mr. Sydney E. Smith, who has resigned, on his appointment as manager of the British and Colonial Aeroplane Co., Ltd. After joining Mr. Challenger, Mr. Munton will still retain special charge of the outdoor electrical equipment.

The Highways Committee of the L.C.C. received 48 applications for the post of traffic assistant at £600 per annum. A subcommittee selected seven of these, and four were interviewed, with the result that Mr. Lewis Slattery, general manager of the Oldham Corporation Tramways, is recommended for the appointment.

The Handsworth U.D.C. has reappointed Mr. Geo. Conaty as tramway expert for six months at an inclusive fee of £100.

General.—During the royal visit to South Africa the Duke of Connaught laid the foundation stone of the new English church at Bulawayo, with full Masonic ceremonial. A silver trowel was presented to his Royal Highness by Wor. Bro. E. A. Uttley, the Government electrical inspector at Bulawayo. Before his departure the Duke presented Mr. Uttley with a signed photograph of himself.

Mr. Herbert A. Jones, for the past 11 or 12 years formerly as manager, and for many years lately as managing director of the Phœnix Dynamo Manufacturing Co., Ltd., Bradford, has resigned his position, and in the new year is commencing business in London in partnership with Mr. T. K. Irwin (for many years general manager of John Butler & Co., Ltd., Stanningley Ironworks, Leeds), under the style of Irwin & Jones, engineers and agents, 5, London Wall Buildings, London, E.C. Mr. Jones, who will be glad to hear from his many friends at the above address, carries with him into his new business the good wishes of a very wide circle of acquaintances.

Mr. C. J. Margerison, departmental manager of Messrs. Wm. Geipel & Co., has been made the recipient of a handsome oak bookcase on the occasion of his marriage, which takes place on December 26th.

Mr. George Balfour, who ran as Unionist candidate for Govan, is a partner in the firm of Balfour, Beatty & Co., Ltd.

Obituary.—The *Times* records the death, which occurred on 15th inst., at Colombe Lodge, Ealing, of pneumonia, of Mr. James Meldrum, M.Inst.C.E., F.R.G.S., F.Z.S.

Mr. J. R. Salter.—We deeply regret to record the death, which occurred on Friday last, of Mr. J. R. Salter, general manager of the South Lancashire Tramways. Mr. Salter suffered for a few days from pneumonia, as the result of a chill, and an operation became necessary, but it failed to save him. The deceased gentleman, who will be greatly missed by a very wide circle of friends in the electric tramway world, has passed away at the early age of only 35 years, he having been born in 1875, but in a brief career he had made remarkable progress. Mr. Salter was privately educated by Prof. Wilson at King's College, and in 1893 he became assistant to the late Dr. John Hopkinson, remaining with him until the latter's death in 1898. He assisted Dr. Hopkinson in his consulting practice, and especially in connection with his patent and laboratory work, also with electric lighting and tramway installations at Crewe, Leeds, Liverpool and Stafford. Shortly after Dr. Hopkinson's death, Mr. Salter became chief assistant engineer to Sir (then Mr.) Clifton Robinson, under whom he was responsible for the electrical construction and equipment of the London United and the Bristol tramway systems, which involved a capital expenditure of about £3,000,000. Mr. Salter was responsible for the negotiations with the Kew Observatory in regard to the electrical disturbance caused by earth currents. In 1902 he was appointed engineer-in-chief to the South Lancashire Tramway Co., and was responsible for the construction and equipment of that company's system of inter-urban tramways connecting Liverpool and Manchester. Upon the completion of these works he organised the staff—both engineering and traffic—being subsequently appointed general manager, which position he held up to the date of his death, as he did also the post of managing director of the St. Helens Tramway Co., of which he had been appointed general manager in 1903. Mr. Salter acted as consulting engineer to the Pemberton Urban District Council and to the Heywood Corporation, and on many occasions he has given evidence before Parliamentary Committees upon electrolysis and other general questions of electric tramway interest. He was lately retained by the L.U.T. as expert in connection with the handing over of the London United Hammersmith Tramways to the L.C.C. Mr. Salter was one of the promoters of the Brighton and Hove District Tramways and several other Bills that have been lodged for consideration in the next Parliamentary session. It will be remembered that in May last he read a paper on "Tramway Economics" before the Tramways and Light Railways Association, of which he was a member of Council. Death occurred at his residence at Park Hill, Broad Oak Park, Worsley. The funeral took place on Monday afternoon, at St. Mark's, Worsley Parish Church. Amongst other representatives of the South Lancashire Tramway Co. present, were the Hon. Arthur Stanley, M.P. (chairman of the company), Mr. Lancaster, superintendent, and Mr. Edwards, resident engineer. Several hundreds of the company's workmen, including some 150 drivers and conductors, attended the last rites, eight of the motor-men and conductors acting as bearers. Many representatives of local public authorities through whose areas the South Lancashire Co.'s system runs also attended as a mark of respect. Whilst the burial service was in progress, traffic on the company's system was suspended.

CITY NOTES.

Prospectuses.

The Shuman Engine Syndicate, Ltd.—This week there has been appearing in the Press "for public information only" a prospectus of this company, whose nominal capital is £55,000, and of which Messrs. A. S. E. Ackermann and C. T. Walrond are consulting engineers. The company is to acquire and exploit the rights of Mr. Frank Shuman in certain improvements in steam engines by means of which the same brake-horse-power is said to be obtained "on 20 per cent. less steam than that used in any existing type of engine."

The Warner International and Overseas Engineering Co., Ltd.—A prospectus of this company has been in circulation this week inviting the public to take up £54,000 (in £1 shares). A further 26,000 shares will be issued fully paid as part-payment of the purchase money. The company is to acquire all the British and foreign rights connected with the Warner patent non-parallel axle. An estimate of profits is published. The list was to close on Wednesday last.

British Columbia Electric Railway Co.

On Monday Mr. R. M. Horne-Payne presided over the fourteenth ordinary general meeting, held at the Great Eastern Hotel, Liverpool Street, E.C.

The Chairman, in moving the adoption of the report (see Electrical Review, page 953), said that once again they were able to chronicle satisfactory progress and expansion of business and good future prospects. The year under review, and the current year up to the present time, had been essentially a period of expansion and continuous re-organisation, but he was glad to say they seemed now to have reached a period of more gradual development—a period of settling down to steady, regular conditions of prosperous commercial life in the cities and districts which they served. This period of development of their territory had put a great strain on the directors and managers; first, owing to their anxiety to act prudently and not to involve the company in any capital expenditure which was not needed and justified by permanent developments; and secondly, in continuous efforts to keep the organisation apace with the increase of business. The demands on the general manager, assistant general managers and other senior officials had been very great, and they all owed them a debt of deep gratitude for their devoted and loyal service. The strain of making provision for the efficient organisation of a business which, in three years, had considerably more than doubled in all departments, and of, at the same time, designing and making careful arrangements for new construction involving the most difficult engineering problems and the expenditure of hundreds of thousands of pounds, could well be imagined. From the shareholder's point of view, nothing could be more satisfactory than the development which had taken place, and was taking place. It was true that it had involved large capital expenditure, and would involve, he hoped, large, although less rapid, capital expenditure for some years to come. He would be very sorry to have his money invested in any enterprise in a new country which did not justify continuous extension. He was glad to say that these extensions of theirs were justified on present sound, permanent conditions, and were not entirely based on the future. Take the new line from Westminster to Chilliwack, a distance of 65 miles; three years ago, when they decided to build that line, they did so to meet the urgent demand of the settlers, and knowing the country through which it would run to be of a marvellously fertile nature; but, nevertheless, when they decided to build it they fully believed that the line would not do more than pay working expenses for some years after it was opened, and they faced the fact that, in order to acquire a very valuable business at the end of nine or ten years, their old lines would have to carry the new one as a burden in the interval. Their fears in this respect had proved groundless; after a few weeks' working the management were able to report that almost from the outset they would be able to earn 5 per cent. on the £400,000 which the line and its equipment had cost. This money had been earning nothing during construction, which was also the case with large sums of money spent on the construction of other extensions in the neighbourhood of Vancouver and New Westminster, and on the hydro-electric power installations near Victoria and Vancouver. The major portion of these works had either been recently completed, or would be completed during the next three months, and would increase their revenue in the future. They must not think from what he had said that the new lines were suddenly going to earn profits at the same rate as the old ones had done in the past; their earning power must naturally be much lower for some years to come, and they would necessarily increase the expense ratio of the whole system: but if they only earned the barest interest on their cost at present, the shareholders should be well satisfied, as they were beyond all question building up a splendid business for the future. The new line to Chilliwack practically bisected the territory which the company's lines serve on the main lands of British Columbia, a territory which is believed to be, perhaps, more prolific in advantages to the home seeker and settler, who has a small capital to

start with, than any country in the world. Within this territory were the cities of Vancouver and New Westminster, and, apparently they were to have in the near future a third great industrial centre on the south bank of the Fraser, where several large manufactories were locating. It was, therefore, not surprising that the territory was settling up quickly. For 14 years at that meeting he had been in the habit of telling them of the progress of Canada and of the opportunities that it offered for investment from Atlantic to Pacific. He would not now detain them with this subject, not that it was any less attractive than it always had been, but in these days so much space was given to Canada by our daily papers that they knew as much about it as he himself did. Many shareholders had written complaints with regard to the delay in the payment of the final dividend. This had been absolutely unavoidable, and was due to the rapid growth of the business. The law did not permit an English company to pay its dividend until the accounts were audited and adopted by the shareholders, and although the London secretary went out to British Columbia to help the assistants there, it had not been possible to submit the accounts sooner.

Mr. E. Maes Harvey seconded the motion.

Replying to questions by the shareholders, Mr. Brown said that the company possessed about 150 miles of railway, and there were in addition some 13 or 14 miles under construction. The board proposed to issue a map showing the company's possessions in British Columbia. The company's plant was hydraulic, with a steam plant as a stand-by; the lighting power was used for railway lighting purposes.

The report was adopted.

On the motion of Mr. Harold G. Brown, seconded by Mr. Evan-Thomas, a resolution was passed authorising the increase of the capital of the company to £3,200,000 by the creation of 700,000 shares of £1 each.

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

Major Leonard Darwin presided on Tuesday at the offices, 106, Cannon Street, E.C., over the forty-seventh ordinary general meeting.

The Chairman, in proposing the adoption of the report (see Elec. Rev., page 997), said they could congratulate themselves that in spite of a very trying year they were able to lay such a satisfactory statement before the shareholders. The abnormally high prices of raw india-rubber which ruled during the spring and summer of this year were within the knowledge of everyone, and he need not dilate on this subject. The anxiety of the board was increased during the year by the desire not to speculate unduly in an abnormally speculative market, while keeping the works supplied with a sufficiency of raw material. The directors thought that, on the whole, a difficult situation had been reasonably met, but it was felt to be prudent to make the special reserve of £30,000 against stocks. He did not wish, nor would it be proper in the interest of the shareholders, to state any opinion as to the trend of the market during the present season, but they, in common with every other manufacturer of india-rubber goods, viewed with pleasure the development of india-rubber cultivation, and would continue to give those engaged in it such assistance as lay in their power. The quantity of this rubber which would eventually be produced would be very large, and plantation rubber would form an important feature in the raw rubber market. It was, therefore, to be hoped that those producers who would establish a reputation for the quality of their produce, would jealously maintain that reputation so that the confidence which was necessary between buyer and seller might not be unduly disturbed. This care should be all the greater because plantation rubber was not, strictly speaking, a raw product; it was partly manufactured, and therein lay the danger so far as quality was concerned. Speaking generally, the business done during the year at the Silvertown and Persan works showed an advance in turnover. The Palmer cord tire which they manufactured for the Palmer Tyre, Ltd., was in increasing demand on account of the high reputation it enjoyed in the motoring world. In his remarks on the last two or three occasions at these meetings, he had not referred to the local taxation question, because the increases had, for the time being, been arrested. They had occasion, as ratepayers to appear against the West Ham Corporation, to protest against the manner in which the question of loans and account-keeping was treated, with the result that their intervention was justified, things were changed, and their expenses in connection with the matter were paid. The high rating which still existed in the district was a great handicap to manufacturing industries. They had had to join in a protest against the Port of London Authority which was charging the maximum rates allowable by Act of Parliament. Their agencies abroad had, as a whole, done a profitable business during the year. The new depôt and agency which they had established at Christchurch, New Zealand, was opened in July last, and they hoped would prove remunerative. He moved: "That the report for the year ended September 30th last be received and adopted, and the dividends recommended paid."

Mr. R. Kaye Gray seconded the motion.

Mr. C. A. Flint pointed out that the dividend was arrested some years ago, and the reason was given that the revenue for the year had been charged with amounts expended on the development of a new business which had not then reached a remunerative stage. That dividend which was then kept back had never been paid, and he asked what the business then referred to was, and if it was now remunerative.

The Chairman said he believed the allusion was to the Palmer tire development, which had certainly proved a very satisfactory element in their trade, and was still growing. They continued to put aside a regular reserve against that, but it was certainly a most profitable part of their business, and they did not in the least repent having undertaken it.

Mr. C. A. Flint urged that as the shareholders were deprived of their dividend some years ago, and as £500,000 had been retained in the business, it was only fair that it should be made up to them, and he suggested that some portion of the £30,000 special reserve against stocks should be utilised for this purpose.

The Chairman said the board were doing what they honestly believed was in the interests of the shareholders, and in the state of the rubber market it would be wrong to pay away more than they had proposed. By placing this large sum against stocks they were giving a certain indication to the shareholders that rocks were ahead. They looked forward with confidence to the future, but when they had stock of raw material purchased at a high price, and when they had prices dropping, every manufacturer knew that the situation was a difficult one. The board faced that situation with confidence, but they recognised that it was a difficult one, and, under such circumstances, he repeated that it would be distinctly wrong to recommend more dividend being paid.

Mr. Flint said he did not ask for the dividend to be paid at once, but that it should be set aside, because once it got out of their control it went into the bottomless pit, and the shareholders saw nothing more of it.

The Chairman pointed out that they had always paid the full dividend except on one occasion, and in declining to pay more than was recommended, he was sure they were doing the best for the company.

Mr. Flint desired to move an addendum to the resolution to the effect that out of the £30,000 proposed to be set aside for special reserve against stocks, a sum sufficient to pay 2½ per cent. to the shareholders be ear-marked for distribution when the board thought fit.

The Chairman ruled the suggested amendment out of order.

The report was adopted.

On the motion for the re-election of the auditors, Mr. Flint raised the question of the absence of details of the accounts of any of the concerns in which the company was interested, and said he protested against the way their money was taken out of their control.

The Chairman said the company had no power to do this, and he did not think it was a proper request to make. If the shareholders desired, it was within their power to change the auditors.

The motion was carried, and the meeting concluded with the usual vote of thanks to the board.

Stock Exchange Notices.—Applications have been made to the Committee to allow the following securities to be quoted in the Official List:—

Buenos Ayres Lacroze Tramways Co.—£350,000 5 per cent. extension mortgage debentures.

Para Electric Railways and Lighting Co., Ltd.—Further issue of 7,893 ordinary shares of £5 each, fully paid (Nos. 148,001 to 155,893).

Sao Paulo Tramway, Light and Power Co., Ltd —6,000 additional shares of $100 each.

A.E.G.-Lahmeyer Works.—As a result of the recent general meetings of the A.E.G. and the Felten & Guilleaume-Lahmeyer Works, the A.E.G.-Lahmeyer Works Co. has been formed at Frankfort-on-Main to take over the Frankfort department of the F. & G.L. Co. The share capital amounts to £500,000. Messrs. Imhoff, Jordan & Schmidt, managers in the old company, continue in the new company, whilst Mr. Astfalck, another manager, becomes one of the directors of the new company in association with members of the A.E.G. The whole of the share capital passes into the possession of the A.E.G. in exchange for new shares in the latter of the amount of £561,150, which become the property of the Felten & Guilleaume Co.

T. Sugden, Ltd.—The directors have declared a dividend, payable forthwith, of 15 per cent., being the same rate as for the last year.

Calcutta Electric Supply Corporation, Ltd.—The number of units delivered to consumers during the four weeks ended November 25th, 1910, were 626,393, compared with 581,567 units in the corresponding four weeks of 1909.

Telephone Co. of Egypt, Ltd.—The register of transfers of 4½ per cent. redeemable debenture stock is closed from December 19th to 31st, both days inclusive, for the preparation of warrants for the half-yearly interest due January 1st, 1911.

Oriental Telephone and Electric Co., Ltd.—The register of transfers of 4 per cent. redeemable debenture stock is closed from December 19th to 31st inst., both days inclusive, for the preparation of warrants for the half-yearly interest due January 1st, 1911.

Ernest Scott & Mountain, Ltd.—According to the *Financier*, the report states that, after providing for debenture interest, &c., the accounts for the year to June 30th show a loss of £5,750, increasing the debit balance of £13,999 brought down to £19,749.

MARKET QUOTATIONS.

Wednesday, December 21st.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a „ Nitric	„	22/-	..
a „ Oxalic	„	23/-	..
a „ Sulphuric	„	5/6	..
a Ammoniac, Sal	„	42/-	..
a Ammonia, Muriate (crystal)	per ton	£29	..
a „ „	„	£30	..
a Bleaching powder	„	£5 10	..
a Bisulphide of Carbon	„	£18	..
a Borax	„	£16	..
a Ferro-Silicon (50 %)	„	£9 10	..
a Copper Sulphate	„	£18	..
a Lead, Nitrate	„	£25	..
a „ White Sugar	„	£22 15	..
a „ Peroxide	„	£32	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, in casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %)	per ton	£20	..
a „ Chlorate	per lb.	3½d.	..
a „ Perchlorate	„	4½d.	..
a Potassium, Cyanide	„	7d.	..
a Shellac	per cwt.	85/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers	„	£6 10	..
a „ Recovered	„	£5 10	..
a „ Lump	„	£5	..
a Soda, Caustic (white 70 %)	„	£11	..
a „ Chlorate	per lb.	3½d.	..
a „ Crystals	per ton	£3 5	..
a Sodium Bichromate, casks	per lb.	8d.	..
a „ Cyanide (basis 100 %)	„	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	£80	..
b „ Wire, in ton lots	„	£112	..
b „ Sheet, in ton lots	„	£120	..
p Babbitt's metal ingots	„	£38 to £145	..
c Brass (rolled metal 2" to 12" basis)	per lb.	6½d.	..
c „ Tube (brazed)	„	8½d.	..
c „ „ (solid drawn)	„	7d.	..
c „ Wire, basis	„	6½d.	..
c Copper Tubes (brazed)	„	9d.	..
c „ „ (solid drawn	„	8½d.	..
g „ Bars (best selected)	per ton	£72	£1 dec.
g „ Sheet	„	£72	£1 dec.
g „ Rod	„	£72	£1 dec.
e „ (Electrolytic) Bars	„	£60	..
e „ „ Sheets	„	£76	..
e „ „ Rod	„	£63 15	..
e „ „ H.C. Wire	per lb.	8d.	..
f Ebonite Rod	„	6/-	..
f „ Sheet	„	5/6	..
n German Silver Wire	„	1/11	..
h Gutta-percha, fine	„	8/6	..
h India-rubber, Para fine	„	5/10	3½d. dec.
l Iron Pig (Cleveland warrants)	per ton	49/11	4d. inc.
l „ Wire, galv. No. 8, P.O. qual.	„	£14	..
g Lead, English Ingot	„	£13 10 to £13 15	2/6 inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£8	..
d Mica (in original cases) small	per lb.	6d. to 1s.	..
d „ „ „ medium	„	2/6 to 4/-	..
d „ „ „ large	„	4/6 to 8/6	..
p Phosphor Bronze, plain castings	„	11d.	..
p „ „ rolled bars & rods	„	1/0½	..
p „ „ rolled strip & sheet	„	1/1	..
o Platinum	per oz.	160/-	..
e Silicium Bronze Wire	per lb.	9d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	„	£172 to £173	£5 inc.
n „ Wire, Nos. 1 to 16	per lb.	1/11½	½d. inc.
p White Anti-friction Metals	per ton	£45 to £150	..
k Zinc, Sh's (Vieille Montagne bnd.)	„	£29 15	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Montreal Street Railway Co.—The Montreal correspondent of the *Toronto Globe* says: "It is stated here that the financial plans of the syndicate which controls the Street Railway stock are gradually maturing, and that in the course of the next few months a large block of stock will be retired and debentures sold against it in London. At the present time nearly $9,000,000 is tied up in Street Railway stock, and if these loans are released it will give no little impetus to the local market. It is believed that interests identified with Vickers, Sons & Maxim, who took a large interest in the syndicate which purchased the control of the Street Railway, will be prominently identified with the debenture issue across the water."—*Financial News.*

United River Plate Telephone Co., Ltd.—An interim dividend of 3 per cent. on the ordinary share capital, free of tax, for the half-year ended September 30th, is announced.

Shawinigan Water and Power Co.—A quarterly dividend of 1 per cent. has been declared on the common stock, payable January 20th.

STOCKS AND SHARES.

Tuesday Evening.

WHETHER anyone wants, or does not want, to read about such dry subjects as finance and money at this cheery season of the year, boots naught to the conscientious scribe. He may feel that to give the wildest of tips, to discuss the relative merits of oil and electricity, or to detail the particular presents for which his soul (or his cigar-holder) pines, will be equally valuable in view of the extreme probability that nobody but the equally conscientious proof-reader will weary his eye with what he may write. However, this is neither here nor there, and the ardent longing to go and buy inexpensive Christmas presents—such as radiators, electric fans, irons, broughams, toasting-irons and flash-lamps—must be rigorously repressed for two or three hours, the exact time being regulated by the workings of the financial, albeit prosaic, Muse.

To turn from the sublime to the Underground, it has to be noted that the demand for Home Railway stocks, which is one of the few features of the markets, has extended to Metropolitan Consolidated and District Ordinary, both of which show rises. The showers which so effectually laid the dust last week were mentioned as a reason why the last few traffics of the year should show up well, but this sorry effort was overruled by the more practical consideration that next month's dividend deductions will be good. District 4½ per cent. first Preference attracts buyers round about 86, and a fair amount of trade is doing in the 3½ per cent. Assented Preference at 75. The interest on this last-mentioned stock is guaranteed by the Underground Electric Railways Co., and the yield, allowing for the accrued dividend, works out to about 4¾ per cent. on the money.

The bonds of the Underground Railway itself are better, the Fives at 101½ and the 4½ per cents. at 96. East London Ordinary has risen ¼ to 3¾, and its four Debenture stocks are a rather better market at 98, 24, 6 and 5, according to the first few letters of the alphabet.

No firmness in Home Rails seems to afford any assistance to the older electrical railway issues. Central Londons are unchanged. City and South London is ½ lower, although if the company is able to maintain its dividend on the Ordinary, the stock will pay very nearly 6½ per cent. on the money. It is a striking anomaly that City and South London should stand at almost exactly the same price as District Ordinary, which has received no dividend for 28 years, and whose chances of getting however small a distribution lie probably several years ahead even now.

The Telegraph Market has been once more in the thick of an existing gamble in Anglo-American Telegraph issues, in the course of which the Deferred lost most of its substantial rise of last week, but recovered it later on. The provisional agreement with the Western Union Telegraph Company is expected to give Anglo "A" about 1½ per cent. annual dividend. American Telephone and Telegraph capital stock continues to grow steadily in value. Direct United States shares have fallen 7s. 6d., and look weak, although not much buying would be required to put the price better again. A somewhat overlooked feature in the Telegraph Market is the rise of several points in Western Unions, which are now up to about 74. The market is almost entirely in New York and Boston; dealings do take place on this side, though rarely, and the price is to be found daily in the cabled columns of the Wall Street Stock Exchange quotations. Western Telegraphs are the turn easier, and Amazons ⅛ higher.

Globe Ordinary recovered the dividend of 2s. deducted last week, while the Preference, *ex* 3s., are ⅛ down. Mackay Companies' shares are *ex* dividend, without making appreciable difference to the middle prices.

The little excitement which recently raised National Telephone Preferred and Deferred has quieted down, and the latter shows a tendency to slip back. Marconi's at 1⅛ are down $\frac{1}{16}$, which is a similar decline to that of last week.

India-Rubber shares gained a further 5s. on the dividend announcement given here last week. Henley's maintain their improvements, and the manufacturing list, as a whole, keeps very steady.

Notwithstanding the fact that the Brazilian "rebellion" is supposed to be quenched again, Rio Trams have been a dull market, sliding back to 104. Mexico Trams, on the other hand, are a trifle better, and Mexican Light and Power descriptions have not varied. The market in all of these Latin-Canadians is very quiet for the time being. Tramway stocks and shares are mostly neglected, and a fall of $\frac{1}{16}$ in Anglo-Argentine Second Preference is almost the only change.

Electricity supply shares are none too good. Small declines have occurred in several of the leading shares, and the market is rather apprehensive in regard to the coming dividends. There are, however, no especial features.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Dec. 13th.	Closing Quotations Dec. 20th.	Business done week ended Dec. 20th, 1910.		Rise + or Fall —	Present Yield per cent
		*	1906.	1907.	1908.	1909.			Highest	Lowest.		£ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	Nil	5⅛— 6	5⅝— 6¼	5⅞	..	+ ⅛	Nil.
286,500	Do. 5 % Deb. Red. Iss. at 98 % script all paid	Stock	5 %	5 %	5 %	5 %	97 — 99	97 — 99	..	..	..	5 1 0
$255,196,000	American Telephone & Telegraph, Cap Stock ..	$100	8 %	8 %	8 %	8 %	144 —146	145 —147	..	..	+1	5 8 10
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
558,460	Anglo-American Telegraph	Stock	3¾%	3¾%	£3 4s.	3¾%	69½— 71½	69 — 71	70	69½	— ½	5 2 1
3,220,770	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	6 %	112 —114	112 —114	114½	112¼	..	5 5 3
3,220,770	Do. do. do. Deferred	Stock	1¾%	1 %	8/-	25/-	29¼— 29¾	28½— 28⅝	29 1/16	28 3/16	−1	4 6 11
47,725	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	8 %	8 %	8 %	8 %	7 — 7¼	7 — 7¼	6 31/32	6⅞	..	5 10 4
2,449,176	Commercial Cable, Stlng. 500 year 4% Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	86⅝	..	..	4 12 0
16,000	Cuba Telegraph	10	5 %	6 %	6 %	6 %	8½— 9½	8½— 9½	..	..	..	6 9 9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	10 %	16⅝— 17½	16⅝— 17½	..	..	..	5 15 11
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3¾	3⅜— 3¾	..	..	..	5 1 7
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8½— 8⅝	8½— 8⅝	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	101 —103	101½—103½	..	..	+ ½	4 7 0
60,710	Direct United States Cable	20	4½%	4½%	4½%	4 %	15⅝— 16⅛	15¼— 15⅝	15⅝	..	— ⅜	5 1 7
	Direct W. India Cable, 4½% Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	101 —103	101 —103	..	..	..	4 7 5
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	135 —138	135 —138	136	135	..	5 1 5
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	83 — 85	83 — 85	84½	84	..	4 2 4
1,896,706	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	99½—101½	99½—101½	100¼	..	..	3 18 10
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12¾— 13¼	12¾— 13¼	13⅜	12 13/16	..	5 7 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..	3 18 5
200,000	East. & S. Afric. Tel., 4 % Mt. Db. Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	99½—101½	99½—101½	..	..	..	3 18 10
181,127	Globe Telegraph and Trust	10	5½%	5⅞%	5⅞%	5⅞%	10½— 10⅝	10½— 10⅝ xd	10⅝	10 15/32	..	5 9 5
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13¼— 13⅜	13¼— 13⅜ xd	13 3/16	..	..	4 7 3
150,000	Great Northern Telegraph, of Copenhagen..	10	20 %	20 %	18 %	18 %	30½— 31½	30¾— 31¾	..	..	..	5 14 9
17,000	Indo-European Telegraph	25	13 %	13 %	13 %	13 %	53 — 55	53 — 55	..	..	..	5 18 7
$41,380,400	Mackay Companies Common	$100	3½%	4 %	4 %	4½%	90 — 95	92 — 94 xd	..	..	..	4 9 6
$50,000,000	Do. do. 4% Cum. Pref.	$100	4 %	4 %	4 %	4 %	75 — 80	76 — 78 xd	..	..	..	5 0 0
394,190	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	11/16— 13/16	9/16— 3/4	13/6	..	— 1/16	Nil
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	6 %	6 %	6 %	6 %	7/8— 1	7/8— 1	18/1½	..	..	6 0 0
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	29/32— 30/32	29/32— 30/32	..	..	..	5 11 1
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106 —107	106 —107	106¼	..	..	5 12 2
3,725,000	Do. do. Def. Stock	100	5 %	6 %	6 %	6 %	128 —130	127 —129	129	127½	−1	4 13 0
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	10½— 10⅝	10½— 10⅝	..	..	..	5 10 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	5 %	6 %	6 %	6 %	10½— 10⅝	10½— 10⅝	..	..	..	5 10 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 1/16— 5 1/8	5 1/16— 5 1/8	5 1/16	..	..	4 10 0
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 —101	99 —101	..	..	..	3 9 4
1,983,593	Do. do. 4 % Deb. Stock Red... ..	100	4 %	4 %	4 %	4 %	99 —101	99 —101	99	..	..	3 19 3
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid..	1	7 %	8 %	8 %	8 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..	4 14 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 1/16— 1 1/8	1 1/16— 1 1/8	23/9	..	..	4 7 3
195,955	Do. do. do. 4 % Red. Deb. Stock..	100	4 %	4 %	4 %	4 %	88½— 90½	88½— 90½	..	..	..	4 8 5
99,400	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 7
11,889	Reuter's	8	5 %	5 %	5 %	5 %	7⅞— 8	7⅞— 8	..	..	..	5 0 0
145,955	Telephone Co. of Egypt, 4½ % Deb. Red.	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 9 7
3,042	Submarine Cables Trust..	Cert.	6 %	6 %	6 %	6 %	132 —135	132 —135	..	..	..	4 8 11
120,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	7¼— 7⅜	7¼— 7⅜	7¼	7 7/16	..	5 6 8
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	5 3/8	5⅝	..	4 6 11
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	2½%	2½%	2½%	2½%	1 1/16— 1 1/16	1 1/16— 1 1/16	..	..	..	4 12 8
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..	3 19 3
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	7 %	13⅝— 13¾	13½— 14 xd	14	13⅝	..	4 17 5
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101—103	101 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	1 1/16— 1 1/16	1 1/16— 1 1/16	28/3	26/6	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	8 %	6 %	6 %	6 %	9⅜— 9½	9⅜— 9½	9⅜	9 3/32	..	6 4 8
4,669	Do. do. 6 % Cum. 2nd Pref	10	Nil	£2 6	15 %	14½%	8¾— 9¼	8¾— 9¼	..	..	..	6 9 9
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	102 —104	102 —104	..	..	..	4 16 2

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

640,000	Anglo-Argentine Trams, 5% Cum. 1st Pref. 1 to 640,000	5	..	..	..	5 %	4 13/16— 5 1/16	4 13/16— 5 1/16	100/-	97/6	..	4 18 9
500,000	Do. 5 % 2nd Pref., 800,000 to 1,300,000	5	..	..	..	5 %	4⅜— 4⅝	4 7/16— 4 11/16	91/10½	88/9	— 1/16	5 9 7
4,465,674	Do. 4 % Deb. Stock	Stock	..	..	4 %	4 %	92 — 93½	92 — 93½	93½	92½	..	4 5 7
332,387	Auckland E. Trams, 5 % 1st Mort Deb. Stock ..	100	5 %	5 %	5 %	5 %	103 —105	103½—105½	105	..	+ ½	4 14 9
530,000	Babcock & Wilcox, 1 to 530,000	1	20 %	20 %	20 %	24 %	5⅜— 5⅞	5⅜— 5⅝	5⅜	5 1/16	..	4 2 7
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅜— 1½	1⅜— 1½	..	..	..	4 0 0
1,000,000	British Aluminium 5 % Mort. Debs. Red.	100	..	..	..	..	..	..	..	..	..	5 9 7
500,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	8 %	8 %	8 %	146 —150	146 —150	148½	147⅜	..	5 6 8
400,000	Do. Pref. Ord. Stock	100	5 %	5 %	6 %	6 %	123 —127	123 —127	126⅝	125½	..	4 14 6
400,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	110½—113½	110½—113½	111½	..	..	4 8 1
233,000	Do. 4½ % 1st Mort. Deb., 1 to 6,250	40	4½%	4½%	4½%	4½%	102 —104	102 —104	..	..	..	4 6 7
212,600	Do. 4½ % Vancouver Power Debs., 1 to 2,000	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
133,301	British Electric Traction	10	Nil	Nil	Nil	Nil	7/8— 1⅛	7/8— 1⅛	22/6	17/6	..	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	3 %	1¾%	Nil	3⅝— 3 13/16	3¾— 3 15/16	70/7½	68/9	..	Nil
1,473,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	89 — 93	89 — 93	..	..	..	5 7
528,936	Do. do. 4½ % 2nd Deb. Stock Red.	100	4½%	4½%	4½%	4½%	74 — 79	74 — 79	..	..	..	5 12 6
100,000	British Insulated and Helsby Cables	5	10 %	10 %	10 %	10 %	6⅜— 7½	6⅜— 7½	..	..	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅜ 6	5⅜ 6	6	..	..	5 0 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
201,579	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 75,000	5	Nil	Nil	Nil	Nil	⅛— ¼	⅛— ¼	7/6	..	..	Nil
1,816,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 62	59 — 62	..	..	..	6 9 1
50,000	‡Browett, Lindley & Co., Ord.	1	Nil	Nil	Nil	Nil	3/16— 5/16	3/16— 5/16	..	..	..	Nil
50,000	Do. do. 6 % Cum. Pref.	1	Nil	Nil	Nil	Nil	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
140,976	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
200,000	Do. do. Non-cum. 6 % Pref.	2	Nil	Nil	Nil	Nil	0 — ⅛	0 — ⅛	..	..	..	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	37 — 42	37 — 42	..	..	..	10 14 4
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	23 — 27	23 — 27	..	..	..	18 19 3
137,610	Calcutta Trams, 1 to 137,610	5	8 %	6 %	4½%	4½%	4⅜— 5	4⅜— 5	95/3	95/7½	..	4 10 0
45,304	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	5 %	5 %	5 %	5 %	4⅜— 5⅛	4⅜— 5⅛	5 1/2	..	..	4 17 7
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
35,000	Callender's Cable Construction shares	5	15 %	15 %	15 %	10 %	9¼— 9⅝	9¼— 9⅝	9⅜	..	..	5 8 3
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4 15/16— 5 1/16	4 15/16— 5 1/16 xd	..	..	..	4 18 9
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	104 —106	104 —106 xd	..	..	..	4 4 11
491,222	Cape E. Trams., 1 to 491,222	1	Nil	Nil	Nil	Nil	⅛— ⅜	⅛— ⅜	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	8 %	12 %	12½%	17½%	3 — 3¼	3 — 3¼	60/-	..	..	5 8 2
210,153	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4 %	4½%	105 —108	105 —108	..	..	..	4 3 4
1,890,690	Central London Railway, Ord. Stock	Stock	4 %	3 %	3½%	3 %	63 — 65	63 — 65	64	..	..	4 12 4
554,655	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	85 — 87	85 — 87	85½	..	..	4 12 0
554,655	Do. do. Def. do.	Stock	4 %	2 %	2½%	2 %	44 — 46	44 — 46	44½	..	..	4 7 0
1,480,000	City and South London Railway	Stock	2½%	2½%	1¼%	1¾%	26½— 27½	26 — 27	26⅞	26½	— ½	6 9 8
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	5 %	Nil	Nil	¼— ⅜	¼— ⅜	..	..	..	Nil
100,000	Do. 5 % 1st Mort. Reg. Debs., 900 of £100, and 901 11,000 of £50 Red	..	5 %	5 %	5 %	5 %	83 — 86	83 — 86	..	..	..	5 17 8

* Unless otherwise stated, all shares are fully paid. ‡ From Manchester Share List.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued.*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Dec. 13th.	Closing Quotations Dec. 20th.	Business done week ended Dec. 20th, 1910.		Rise + or Fall —	Present Yield per cent.
		*	1906.	1907.	1908.	1909.			Highest	Lowest		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	10 %	10 %	6 %	5 %	7/— 1	7/— 1	..	..	.	5 0 0
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..	5 7 10
271,080	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
60,000	Dublin United Trams. (1896), 6 % Pref., 1 to 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	4½%	2½%	Nil	Nil	0 — 1/8	0 — 1/8	..	..	..	Nil
17,139	Do. "A" shares, 01—017,139	5	4½%	2½%	Nil	Nil	1 — 1½	1 — 1½	..	..	..	Nil
307,895	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	63 — 68	63 — 68	..	..	..	5 17 8
67,720	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	77 — 80	77 — 80	..	..	..	6 5 0
112,100	Electric Construction, 1 to 112,100	2	Nil	Nil	Nil	Nil	3/16 — 5/16	3/16 — 5/16	11/-	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	7 %	1⅜ — 1½	1⅜ — 1½	..	..	..	7 9 4
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	8⅜ — 8⅝	8⅜ — 8⅝	..	..	..	5 15 7
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	80 — 84	80 — 84	..	..	..	4 15 3
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	4 %	½%	Nil	Nil	3/4 — 1	3/4 — 1	..	..	..	Nil
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10½ — 10⅝	10½ — 10⅝	..	..	..	6 10 3
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103½	102 —103½	..	..	..	4 16 10
40,000	Henley's (W.T.), Telegraph Works, Ord.	5	15 %	15 %	15 %	15 %	12½ — 13	12½ — 13	..	..	..	5 15 5
40,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 5/16 — 5 7/16	5 5/16 — 5 7/16	..	..	..	5 4 8
150,000	Do. do. 4½ % Mort. Deb Stock	Stock	4½%	4½%	4½%	4½%	107 —109	107 —109	..	..	..	4 3 4
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10 %	10 %	10 %	10 %	15¾ — 16¼	15¾ — 16¼	16¼	..	+ ¼	6 1 3
37,500	†Liverpool Overhead Railway, Ord.	10	Nil	½%	Nil	Nil	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 15 7
600,070	London United Trams. (1901) 1 to 50,007	10	3 %	3 %	Nil	..	1½ — 2⅛	1½ — 2⅛	..	..	..	Nil
399,930	Do. do. 60,008 to 100,000	10	3 %	3 %	Nil	..	1½ — 2⅛	1½ — 2⅛	..	..	..	Nil
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	3⅜%	Nil	1⅝ — 2⅛	1⅝ — 2⅛	..	..	..	..
1,649,930	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	67 — 71	67 — 71	..	..	..	5 12 8
5,782,062	Metropolitan Consolidated	100	1 %	⅛%	⅛%	1 %	39⅝ — 40	39⅝ — 40⅛	40⅛	39⅝	+ ⅛	4 2 9
2,640,914	Do. Surplus Lands	100	23/4%	23/4%	23/4%	23/4%	64 — 66	64 — 66	..	..	..	4 3 4
3,285,000	Do. District	100	Nil	Nil	Nil	Nil	26 — 26½	26⅜ — 27⅛	27 1/16	26½	+ ⅜	Nil
391,337	Metropolitan Electric Trams., Ord.	1	..	..	4½%	5%	3/— 7/16	3/— 7/16	16/6	..	..	5 14 3
314,016	Do. do. Defd.	1	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	1/6	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	13/16 — 15/16	13/16 — 15/16	17/6	17/-	..	5 6 8
595,600	Do. do. 4½ % Deb. Stock Red.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
$10,823,200	Mexico Trams Co., Common Stock	..	..	..	..	6 %	122 —124	122½—124½	..	..	+ ½	4 16 5
$9,000,000	Do. 1st Mort. 50-year 5 % Gld. Bds.	..	..	..	5 %	5 %	96½ — 97½	96½ — 97½	97	96⅜	+ ½	5 2 7
245,500	Potteries Electric Traction	1	4 %	4 %	Nil	..	3/16 — 5/16	3/16 — 5/16	..	..	..	..
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	3/8 — 1/2	3/8 — 1/2	..	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	80 — 83	80 — 83	..	..	..	5 8 5
37,350	Telegraph Construction and Maintenance	12	15 %	17½%	15 %	17½%	37 — 39	37 — 39	38½	37½	..	5 9 4
140,000£	Do. 4 % Deb. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..	3 17 8
1,000,000	Underground Electric Railway, 5 % Prior Lien	..	..	..	5 %	..	100¼—101½	101 —102	101½	100¼	+ ½	4 18 0
2,800,000	Do. do. 4½ % Bonds	..	..	..	4½%	4½%	94 — 96	95 — 97	96	95½	+1	4 12 9
4,900,000	Do. do. 6 % Income Bonds	..	..	..	..	..	38 — 40	38 — 40	..	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	¼	Nil	10 %	5 %	Nil	1/8 — 3/16	1/8 — 3/16	..	..	..	..
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	6 %	3 %	1 — 1½	1 — 1½	..	..	..	10 0 0
245,495	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	55 — 65	55 — 65	..	.	..	6 3 1

ELECTRICITY SUPPLY COMPANIES.

30,449	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10%	10 %	7 %	10 %	6⅞ — 7⅛	6⅞ — 7⅛	7⅛	..	..	6 15 7
9,551	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	4 14 11
400,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	101	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	5 %	5 %	5 %	5 %	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	5 19 5
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	4 17 4
80,000	Do. "City Undertaking" 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅜ — 4¼	3⅜ — 4¼	..	..	..	5 5 11
445,736	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 — 99	95 — 97 xd	..	..	..	4 2 6
49,486	Chelsea Electricity Supply, Ord.	5	4½%	4½%	4½%	4½%	3¼ — 3⅜	3¼ — 3⅜	71/3	..	..	6 0 0
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	99 —101	97 — 99 xd	..	..	..	4 10 11
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	6 %	6 %	6 %	7 %	11 — 11½	11 — 11½	11¼	..	..	6 1 9
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11½ — 12¼	11½ — 12¼	12¼	11⅜	..	4 19 0
400,000	Do. 5 % Db. Stk.	Stock	5 %	5 %	5 %	5 %	120 —124	120 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk.	100	4½%	4½%	4½%	4½%	99½—102½	99½—102½	102½	..	..	4 7 10
50,000	County of Durham Electrical Power, Ord.	5	4 %	2 %	Nil	Nil	1⅝ — 2	1⅝ — 2	..	..	..	Nil
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	2⅝ — 3⅜	2⅝ — 3⅜	..	..	..	7 16 10
250,000	Do. do. do. 5 % 1st Mtg. Deb.	Stock	..	..	5 %	5 %	94½ — 96½	94½ — 96½	..	..	..	5 3 8
40,000	County of London Electric Lighting, Ord. 1—40,000	10	5 %	5 %	5 %	5 %	7⅝ — 7⅞	7⅝ — 7⅞	..	..	..	6 7 0
55,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11	10½ — 11	10 13/16	10⅜	..	5 9 1
400,000£	Do. do. 4½ % Deb. Stock	Stock	4½%	4½%	4½%	4½%	104½—107½	104½—107½	106⅛	..	..	4 3 9
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	98 —101	98 —101	99½	..	..	4 9 1
80,000	Edmundson's Electric Corporation, Ord. Shares	5	Nil	Nil	Nil	Nil	3/16 — 3/8	3/16 — 3/8	..	..	..	Nil
80,000	Do. do. 6 % Cum. Pref.	5	3 %	Nil	Nil	Nil	1⅜ — 2	1⅜ — 2	..	..	..	Nil
490,500	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	74 — 77	74 — 77	..	..	—1	5 16 11
$8,150,000	Electrical Dev. Co. of Ontario, 5% 1st Mtg. Gold Bnds.	$500	..	..	5 %	5 %	81½ — 84½	81 — 83	83	..	—1½	6 0 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 12 10
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	5 %	5 %	5 %	5 %	4⅜ — 5⅛	4⅜ — 5⅛	..	..	..	4 11 11
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
15,000	Hove, 1 to 15,000	5	9 %	8½%	8½%	8½%	6⅝ — 7⅛	6⅝ — 7⅛	6 13/16	..	+ ⅛	5 19 4
$1,376,000	Kaministiquia Power Co., 5 % Gold Bnds.	100	..	..	5 %	5 %	103½—105½	103½—105½	104	..	..	4 14 9
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	8 %	8 %	6½ — 7	6½ — 7	..	..	..	5 14 3
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	93 — 95	93 — 95	..	..	..	4 4 3
11,000	London Electric Supply Corporation, Limited, Ord.	3	4 %	2½%	3 %	..	1⅜ — 1⅝	1⅜ — 1⅝	28/9	..	..	5 2 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	..	4⅛ — 5⅛	4⅛ — 5⅛	..	..	..	5 17 1
382,355	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4½ %	4½%	4 %	4 %	90 — 93	89 — 92 xd	90½	..	..	4 7 0
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8 %	6½%	5 %	5 %	3½ — 3⅝	3½ — 3⅝	..	..	+ ⅛	6 13 4
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	4 17 4
235,000	Do. 4½ % 1st Mort. Deben. Stock	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
248,000	Do. 3¾ % Mort. Deben. Stock Redem.	Stock	3¾%	3¾%	3¾%	3¾%	82 — 85	82 — 85	..	..	..	4 2 4
$6,000,000	Mexican Electric Light Co., 5% 1st Mtg. Gold Bnds	100	5 %	5 %	5 %	5 %	87⅞ — 88⅜	87⅞ — 88⅜	88½	88⅛	— ⅛	5 12 8
13,585,000	Do. Light and Power Co., Ltd., Common	$100	..	4 %	3½%	4 %	88½ — 90½	8⅜ — 90½	89⅝	88½	+1	4 8 5
$2,400,000	Do. do. 7% Cum. Pref. Stk.	Stock	..	..	7 %	7 %	104½—106½	104½—106½	106	105⅜	+ ⅛	6 11 5
12,000,000	Do. do. 5% 1st Mtg. Gold Bnds.	100	..	..	5 %	5 %	92 — 93	92 — 93	92¾	92	+ ¼	5 7 6
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	97 — 99	97 — 99	..	..	..	4 10 11
130,491	Newcastle-on-Tyne, 1 to 137,500	5	8 %	8 %	2½%	..	3⅜ — 4⅛	3⅜ — 4⅛	..	..	..	2 12 9
137,500	Do. 5 % Pref., 1 to 137,500	5	5 %	5 %	5 %	5 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	5 2 7
150,000	North Metropolitan Electric Power Supply Co., 5 % Mortgages (Red.), Nos. 1 to 1,500	100	..	..	..	5 %	97½ — 99½	97½ — 99½	..	..	..	5 0 6
10,852	Notting Hill Electric Lighting	10	7½%	7½%	7 %	..	11½ — 12½	11½ — 12½	12	..	— ½	5 12 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	7 %	7 %	7 %	7 %	6⅛ — 6⅜	6⅛ — 6⅜	..	..	..	5 3 8
119,694	River Plate Elcty. Co. Ord.	Stock	2½%	6 %	8 %	9 %	228 —238	228 —238	..	..	..	3 15 8
100,000	Do. do. 6% Non Cum. Pref.	Stock	6 %	6 %	6 %	6 %	100 —110	103 —113	110	..	+3	5 6 2
200,000	Do. do. 5% Deb. Stk. Red.	100	5 %	5 %	5 %	5 %	100½—102½	100½—102½	..	..	..	4 17 7
40,000	St. James' and Pall Mall Electric Light, Ord.	5	10 %	10 %	10 %	10 %	7⅜ — 7⅝	7⅜ — 7⅝	7 3/16	..	— ⅛	6 9 0
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅝ — 7⅛	6⅝ — 7⅛	7⅛	7 3/16	..	4 14 1
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	86 — 88	86 — 88	..	..	..	3 19 7
12,000	Smithfield Markets Electric Supply, Ord.	5	Nil	Nil	Nil	..	1⅜ — 2	1⅜ — 2	..	..	..	Nil
65,000	South London Electric Supply, Ord.	4	3 %	4 %	5 %	5 %	2⅝ — 3	2⅝ — 3	..	..	..	6 13 4
130,100	Do. do. 5 % 1st Mort. Deb.	100	..	..	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
120,000	South Met. Elec. Lt. & Power, Ord.	1	2½%	2½%	2½%	..	3/16 — 5/16	3/16 — 5/16	..	..	..	Nil
142,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 3/32 — 1 5/32	1 3/32 — 1 5/32	..	..	..	6 16 7
224,520	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	¼ — 1	¼ — 1	..	..	..	20 0 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	2 — 2½	2 — 2½	..	..	..	10 0 0
275,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	4½%	4½%	4½%	4½%	82 — 84	81 — 83	..	..	—1	5 8 5
808,000	Victoria Falls Power Co., Pref. Nos. 1 to 808,000	1	..	..	5 %	..	3/16 — 5/16	3/16 — 5/16	..	..	..	5 14 3
100,000	Westminster Electric Supply, Ord.	5	12 %	10 %	10 %	10 %	7½ — 8	7⅞ — 7⅞	7 15/16	7 3/32	— ⅛	6 9 0
51,279	Do. do. 4½ % Cum. Pref. (Reduced from 5% since 31st Dec., 1905)	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5 1/16	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4½ per cent. December 1st, 1910

REVIEWS.

International Language and Science. By PROFS. COUTURAT, JESPERSEN, LORENZ, OSTWALD and PFAUNDLER. Translated by PROF. F. G. DONNAN. London: Constable and Co. Price 2s. net.

This book embodies the results of the investigations of an International Commission appointed to consider the general question of an international auxiliary language; after seven years' work, the Commission has decided that the idea is sound, but considers that neither Volapük nor Esperanto has succeeded in providing a solution to the very difficult problems involved. However, the latter has been found to contain a number of good principles, and has been adopted as a basis for the construction of an international auxiliary language. At this stage the authors have thought it well to bring the matter before the scientific and literary world, with a view to its discussion. The symposium presents the views of the respective authors on this important subject in a most interesting manner, emphasising the immense inconvenience and loss resulting from the existing confusion of tongues, and pointing out that the principle of employing a common intermediary is already widely adopted. For example, letters and parcels are collected together at a central point for sorting, instead of dealing with each letter separately at the point of origin; the same applies to telephone lines, &c. A common code of signals is employed at sea, and a common system of weights and measures and of reckoning time is current throughout the world of science. The common language alone is wanting. The principles upon which such a language must be founded are ably discussed, and the difficulties with which the problem is beset are boldly faced. Finally, a sketch is given of the "Linguo Internaciona di la Delegitaro" or "Ido," the international language (a modification of Esperanto) evolved by the Commission.

The object of the movement is highly commendable; and as the promoters have received the support of 310 societies and 1,250 "professors and academicians," there is reason to hope that their efforts will ultimately be rewarded with success. But the perfecting of the language must necessarily be a lengthy process, and many years must elapse before it can command general acceptance. We congratulate the Commission on the work accomplished, and wish it every success.

The Construction and Working of Internal Combustion Engines. By R. E. MATHOT. Translated from the French by W. A. TOOKEY. London: Constable & Co., Ltd. Price 24s. net.

The excellence of this translation of Mathot's work, combined with the re-arrangement, renders it a most valuable addition to the numerous books which have been published within the last few years. Owing to the author's very extensive professional experience with engines manufactured by the most important firms in this country, on the Continent, and in the United States, as well as the large number of tests which he has been called upon to carry out, the whole of the information will be extremely useful, not only to designers, but to all practically interested in modern gas-engine practice.

The matter dealt with is divided into 16 chapters, 10 of which are devoted to the consideration of design, construction and working, the other six treating of associated matters. The descriptive list of illustrations, 466 in number, occupies 12 pages, while only 10 pages are devoted to the index; however, if these be taken in combination the curtailing of the index will be somewhat compensated for.

In a table recording the world's output of gas engines to August 15th, 1908, it is interesting to note that from a single 600-H.P. gas engine built and exhibited in 1900, there were in 1908 no fewer than 28 firms manufacturing units of over 1,000 H.P.; the output amounted to 728 engines, having an aggregate of 1,025,709 H.P., and the size of unit has increased, in double-acting twin tandem types, up to 6,000 H.P.

The tabulation of the proportions of the main parts of constructive details, for a range of seven sizes of cylinder, from 15 to 150 H.P. capacity, will be found particularly useful to designers, and to buyers of engines. The former will be saved much time in detail work, while the latter will be able to compare the proportions given with those of any engine which may be offered to them.

Chapter XVI is probably unique, for it contains a record of no fewer than 138 different tests dating from 1866 up to the present, on gas and oil engines from 575 to 5 B.H.P., in which the results are presented in such a condensed and comparative manner, that it forms a most useful work of reference, covering, as it does, a large range of fuels.

The comparative classification of the engines tested is obtained by the product of four factors—modulus of absolute power, modulus of speed, mechanical efficiency and mean pressure—being considered equal to unity.

The formula for the modulus of absolute power M is: $M = \frac{L \times A}{792{,}000}$, the modulus of speed n being $n = \frac{K\ N}{B.H.P.}$, where K = number of impulses per cycle; N = number of revolutions per minute; and B.H.P. = effective horse-power. The product of these moduli, the mechanical efficiency R, and the mean pressure P_m, enables comparisons to be readily made between various engines.

However, it will be noticed that the figures given in the tables for the modulus of power are not correct, being 10 times too high—the decimal point should be moved one place to the left; also that they have not been very carefully calculated.

With regard to the driving of large gas engines by gas containing a high proportion of hydrogen, it is interesting to note that this work contains a description of engines of the four-cylinder twin-tandem, four-cycle type, of 5,400 H.P. driving alternators, which use oil gas of the following average composition:—

Hydrogen, H_2	58·4
Methane, CH_4	28·8
Hydrocarbons, CHn	3·4
Carbon monoxide, CO	4·4
Carbonic acid, CO_2	1·2
Nitrogen, N_2	3·8
Oxygen, O_2	Traces
	100·0

as well as others with cylinders 16 in. diameter working on natural gas, which contains over 90 per cent of methane.

The 550 pages are full of practical details, very clearly illustrated, and there is little doubt of the work being highly appreciated, as might be expected from the author's previous contributions on allied subjects.

The Student's Catechism on Book-keeping, Accounting and Banking. By FREDERICK DAVEY. London: Butterworth & Co. 1910. Price 3s. 6d. net.

This is a well-printed book, covering, with exercises, 442 pages, and will, no doubt, be found useful for the purpose for which it is intended by those who favour catechisms. It, however, does not contain anything that can be described as new, whilst its full title is hardly justified by 26 or 27 pages on banking, and the somewhat superficial treatment here and there of what is really accounting.

As its title implies, the book consists of an excellent compilation of questions with answers upon book-keeping, commencing with the elements and gradually ascending into the more advanced regions of the subject, being, as it should be, profusely illustrated by worked examples, and concluding with a number of exercises and examination questions for students. The book is also abundantly interspersed with definitions of book-keeping and commercial terms and phrases, and practically resolves itself into a kind of dictionary of book-keeping with the essential accompaniment of terms and phrases in common use.

Many of the answers are good and fulfil the object of an examination; but without being unduly critical, we think that some of the stated questions require much fuller treatment and part correction to be of practical service. For instance, the reply given to the question, "What is a reserve?" is that "it is a sum set aside out of profits to meet a con-

tingent loss or liability, and that it may be either special or general."

Now, there are two kinds of reserves; those which are necessary to enable us to arrive at what are regarded as true profits, and those which are the result of appropriations of ascertained profits. As an instance of the former, we may quote a provision for doubtful debts; the object in this and all other instances of such reserves being the proper support and maintenance of the assets. A real reserve is, or should be, the excess of assets over liabilities, including paid-up capital, and is, consequently, an appropriation of ascertained and available profits. The reply proceeds to state that "reserves may be either special or general, special reserves being created for definite purposes, and are shown as deductions from the assets to which they specially relate," whilst "general reserves are credited for the purpose of strengthening the financial position of a business, and are shown in the balance-sheet as separate items on the Dr. (liabilities) side." Special reserves are not always shown as deductions from the assets to which they relate, though this is the proper course.

In distinguishing between a reserve account and a reserve fund, it is stated that a "reserve account shows on the credit side the amount of the reserve," and that a "reserve fund is an asset which may be in the form of a specific investment or which may be included amongst the general assets of the business."

A reserve, or a reserve fund, may be invested in the business creating it, or it may be invested in outside securities or other forms of investment; but a reserve fund is not an asset. It is a liability, and represents the amount invested inside or outside the business, as the case may be, which is an asset.

In reply to the question "describe the formalities connected with the payment of a dividend to shareholders," it is stated "that as the warrants are presented to the bank for payment, the dividend account at the bank will be debited," &c. This is hardly correct. At convenient times during, or at the end of the financial year, the paid warrants are checked with the entries in the dividend pass-book, and a journal entry made crediting the dividend account at the bank, and debiting sundry shareholders. The words "special dividend account" in Clause 1 might be made clearer by substituting therefor sundry shareholders for dividend; to correspond therewith the account at the bank also should be "numbered." The increasingly important subject of the promotion of subsidiary companies by the sale of properties and the acquisition of cash and shares in exchange therefor receives scant attention, though, as already indicated, the reply given may be sufficient for examination purposes. A discussion of the Garner *v.* Murray partnership case would also have been an improvement.—G. J.

ELECTRICAL WORK FROM CHICAGO TO THE PACIFIC.

Mr. A. A. Gray recently went on a trip from Chicago to San Francisco and back on behalf of the American *Electrical Review and Western Electrician*. In the course of his journeying he made several long detours in order to see features of engineering importance. He has recorded the result of his observations on matters of electrical engineering interest in an article entitled "To the Pacific Coast and Back," appearing in the issue of our contemporary for November 12th, from which we have made the following extracts :—

The writer had occasion recently to make a somewhat extended trip from Chicago to San Francisco and back, making several long detours in order to cover points of engineering interest.

So far as electrical engineering is concerned, it is a fact that it would be hard to make a trip anywhere along the main arteries of travel without finding enough to keep the observer busy.

At Bakersfield a stop of three hours affords an opportunity to visit in an automobile the great oil district for which this country is famous. After a half hour's ride from the Bakersfield station the oil field is reached, where a forest of some 1,800 or 2,000 derricks makes this field one of the most extraordinary producers of this country. The mechanical equipment of the Bakersfield oil district forms an interesting commentary upon the prospect of the utilisation of electrical energy in the oil fields. But little progress has been made in this district in the utilisation of electric motors for any of the work, although in the Eastern oil fields, and, in fact, in other California oil fields, electric motors have demonstrated their superiority to steam-driven apparatus.

It is surprising to find long pipe lines from the central boiler station to the individual engines driving the pumping machinery, the steam piping being in many instances exposed to the atmosphere, where the conditions of condensation must be such as to render the steam service highly inefficient.

In contrast with the Bakersfield district are the Coalinga Fields. Here two wells for the Kern Trading and Oil Co. and one well for the Good Luck Oil Co. have been driven, and these are being operated very economically by alternating-current three-phase induction motors. One of the reasons why the adoption of electrical energy has been delayed is the great range of power required for the various operations of driving and pumping a well. This includes drilling, bailing, sanding, pulling the rods, and pumping, and in order to get a single electrical equipment with a range of power for the necessary requirements there has had to be worked out a very pretty set of winding problems. As a matter of fact, however, the Westinghouse Electric and Manufacturing Co. has installed these equipments, and it is claimed that they are showing remarkable economy. It is estimated that the cost of pumping by electricity, figuring the current at 1½ cents per KW.-hour, can be cut down to $1.50 per day, while pumping with steam engines works out to about $3.50 per day.

These oil fields can be easily reached by the transmission lines from several stations adjacent to the oil fields. Where oil is burned under steam boilers the fuel cost is, of course, very low, but the chemical composition of the water is such that the boilers must be overhauled at frequent intervals, sometimes every three months. In point of economy it appears that where natural gas can be secured as a complementary product of the oil field the gas engine will form a serious competitor of the electrical transmission system, but even where this is the case it would appear to be more economical to install batteries of gas engines driving electric generators and distribute the current economically to individual motors, thus eliminating the inefficiencies of long steam feeders and the great loss in mechanical friction which comes about with the rod and bar and wire drives of the present system. Then again, while the requirements of drilling, driving and pulling call for varying degrees of power, the pumping load is practically a constant run for 24 hours per day, and in point of load factor is almost ideal.

San Francisco, Cal., in view of its population, has probably the most extensive branch office electrical representation of any city in the country. The Pacific Coast States represent a vast manufacturing possibility, but at the present time conditions are not as good as could be wished. San Francisco is suffering from high labour costs, and this is militating against the development of this city as a manufacturing community. With cheap power, however, and the building up of the communities farther back from the coast, and north and south from San Francisco, there is bound to be a wonderful development in the utilisation of manufactured articles of every description, and with the growth of these communities the district is sure to develop large manufacturing interests.

Sixty-cycle alternating current appears to be the prevailing character of electrical distribution in and around San Francisco, while the great system of the Southern California Edison Co. distributes at 50 cycles. Outside of electrical traction there appears to be very little direct current used, and the field here for alternating-current apparatus, particularly alternating-current controlling machinery, would seem to be excellent. There is plenty of enterprise in San Francisco, and the city has made remarkable strides in its rebuilding since the fire of 1906. It will be remembered that the grades of the San Francisco streets are very severe, and it was hardly to be expected that electric vehicles would gain much of a foothold in a city with such topographical characteristics. However, the sale of the electric vehicle is being pushed vigorously and with considerable success, while this type of motor vehicle is rapidly gaining favour in Sacramento, Oakland, Berkeley, and all of the delightful suburban cities adjacent to Los Angeles in Southern California.

At Phœnix, Ariz., the offices and engineering headquarters of the Salt River project of the United States Reclamation Service are located. Here the Government is carrying out one of the greatest irrigation projects in the country and using the fall of the water to generate electrical energy for distribution to the surrounding territory.

The Salt River project purposes the irrigation of about 210,000 acres of reclaimable desert land, and in order to control the flow of the Salt River a massive dam has been built at Roosevelt, about 65 miles from Phœnix, Ariz. This dam is 280 ft. high above bed rock, with a bottom length of 235 ft., and a length at the top of 1,080 ft. It is a masonry arch dam ranging in thickness from nearly 175 ft. at the bottom to 16 ft. at the top, where a highway has been provided for vehicles, concrete bridges carrying the roadway over the spillway to the sides of the canyon on both ends of the dam. Nearly 400,000 cb. yards of masonry have been placed in position to complete the dam, and the reservoir which it will form will create a lake of approximately 16,329 acres in area and backing up 1,400,000 acre-feet of water.

At the site of the dam the canyon is formed of cliffs rising almost perpendicularly, and the power house is built into the rock at the foot of the dam. Power for construction was secured through the

agency of a power canal taken from the head waters about 20 miles from the location of the dam, and this canal forms a part of the permanent hydroelectric development of the project. At the present time at the Roosevelt power house there are three units in place, each of 900-KW. capacity, made by the General Electric Co., driven by 36-in. S. Morgan-Smith water-wheels. The power canal will be a constant-head equipment, while plans have already been formulated for the installation of several other units which will operate under varying heads as the level in the reservoir behind the dam is lowered during the dry seasons.

Power is generated at 2,200 volts. At the transfer station, which is built into the cliff a short distance from the power house, the current is stepped up to 45,000 volts for the transmission system. The three-phase transmission line is in duplicate from the transformer house to Phœnix, Ariz., with a sectionalising station at Mesa, about 18 miles from Phœnix, where several 10,000-volt circuits are taken off for service to the neighbouring community and for distribution to sub-stations, where the voltage is stepped down to 220 volts for the driving of vertical induction motors for pumping.

The Government has built a wagon road from Mesa to Roosevelt, cutting this in many places out of the solid rock of the mountain. It is understood that something like $360,000 was expended upon the construction of this road. It is to be hoped, now that the construction at the dam is practically complete and the need for keeping up the road is not urgent, that the Government will not abandon it, but that steps will be taken to utilise to the fullest extent the wonderful natural beauties of this remarkable canyon. Already the irrigation project has been of great value to the valley. For a period of 13 months there had been no rain, and the crops everywhere, excepting those under the irrigating ditches, were burned up. The water users are enthusiastic over the prospect of reclaiming the land, and it is believed that a ready market will be found for all the electrical energy that can be generated.

In addition to the development at the dam it is proposed to install a number of other stations at different points on the river where the fall will give a sufficient head to generate a considerable amount of power. About 17 miles from Mesa at Granite Reef there is a diversion dam just below where the Verde River flows into the Salt River. A power station will be built near this point. In this way it is expected that the water of the Salt and Verde combined will be used in at least five power stations, and financial arrangements have already been made for the preparation of plans and the construction of machinery for three of these stations.

PROCEEDINGS OF INSTITUTIONS.

Electric Heating and Cooking.

THE following is a synopsis of an address delivered by MR. A. J. CRIDGE before the Yorkshire Section of the INSTITUTION OF ELECTRICAL ENGINEERS at Sheffield on December 7th :—

Cookers are now constructed for use on both A.C. circuits, as in Sheffield, and D.C. circuits, as in some other towns. The charge for electricity in all the cases quoted is taken at 1d. per unit.

With a Tricity cooker, supper for four persons was cooked in 23 minutes, 4 pints of water being boiled, four slices of bread toasted and stew prepared, for the sum of ½d. Breakfast for five persons, consisting of eight rashers of bacon, some potatoes, and four slices of toast, 6½ pints of water being used for all purposes, was prepared in 30 minutes at a cost of ¾d. Supper for seven persons, consisting of steak, ham, kidneys, chipped potatoes, sausages and bacon, was prepared at intervals amounting in all to one hour, for 1$\frac{1}{10}$d.

With another kind of stove, a joint weighing 1 lb. 13 oz. and two fruit pies were cooked properly in under ¾ hour at a cost of 2·7d. With two such stoves, and an extra steamer, a complete six-course dinner for 10 persons was prepared in under 3 hours for the cost of 6d.

Small toasters are capable of toasting four slices of bread at once at a rate of cost equivalent to 160 slices for 1d.

An iron can be made ready for use in about four minutes, and can be kept hot all the time at a cost of less than ½d. per hour.

The "Therol" electric water-heater is capable of supplying 30 gallons per day of very hot water, and in some places the question has been considered of making a fixed annual charge for the supply of electricity to such apparatus. This cost would probably work out at about £3 13s. per annum.

Electric geysers can be connected to the ordinary cold water supply, and the water is heated as it passes through the geyser. In this case there is no consumption of energy when hot water is not required.

Electric glue pots, in which a quart of glue may be kept in condition for use at the rate of six hours for 1d., are frequently used, and the absence of any flame is a great advantage amongst inflammable surroundings. Electric soldering irons are also obtainable.

In the large electric light bath installed at Glossop Road, there are 50 lamps of 60 watts each, and the average time taken by a bath is 20 minutes, representing a cost of 1d. per bath. Electric light baths are considered to be more beneficial than the ordinary Turkish baths.

For intermittent use in bedrooms, bathrooms, offices, or drawing rooms infrequently used, the cost of a radiator does not exceed an average of 1d. per day. The trouble incidental to the use of coal fires, lighting, allowing to die out and cleaning up after use, is entirely obviated by the use of radiators.

Radiators with bright lamps dissipate their energy mostly by means of radiation. Radiators with dull lamps and non-luminous heaters act mainly by convection—*i.e.*, they warm the air around them.

For the prevention of down draughts in public buildings, radiator lamps placed near the roof are frequently employed. As the object is to maintain the air at an even temperature, dull lamps are the best for this purpose. Installations are to be found at several churches and chapels in Sheffield.

Bed-warmers, hat-pads, shaving-mugs and other accessories of this nature are obtainable from many sources, and the cost of using is practically negligible—*e.g.*, the cost of using a hat-pad daily for one year is 2s. 6d.

MR. BERTRAM THOMAS, in a written communication, stated that Gray's patent oven differed from all other ovens in the market, inasmuch as the cooking was not effected by direct radiated heat, but by the flow of heated air over the food. This flow was from the top downwards, so that an efficient top heat was provided and food was very well "browned" by it. The heaters were placed at the bottom of the oven immediately below a flue or flues which opened near the top of the oven. The air coming in contact with the heaters was warmed and rose up the flues to the top of the oven, whence it passed downwards over the food to be cooked, and so returned to the heaters, giving up some of its heat to the food in passing. This method of heating secured a remarkable uniformity of temperature throughout the cooking space, and food could be cooked anywhere inside the oven without burning or being moved—in fact, it was unnecessary to baste joints or poultry. The interior of the oven was kept as tightly closed as possible to prevent escape of the heated air and ingress of cold air. Ventilation was quite unnecessary, and all the water vapour in the oven being superheated to a high degree, it acted simply as a heat-conveying medium. The economy of the system was obvious, as the circulation of the hot air made it unnecessary to heat up masses of material placed in various parts of the oven ; in fact, it was quite possible to imagine the employment of an oven constructed of some material having no thermal capacity, in which the air only would be heated, and in which the losses by convection and radiation would be negligible. The heaters were arranged in parallel-series and controlled by a D.P. two-way switch. With the heaters in parallel, the maximum effect was obtained, and this was used for heating up the oven ; on the series side the temperature of the oven was just about maintained, and the heaters were then only working at one-quarter of their maximum rating. This method of control had two advantages. (1) It was absolutely simple to work, and needed no intelligent selection of the most suitably placed heaters. (2) It increased the life of the heating elements, as for the greater part of the time they were employed upon the lower rating. Provision was made for electrically illuminating the interior of the oven, and a window was fitted in the door, through which the conditions of the food could be observed without opening the door. Every oven was furnished with a thermometer, by which its temperature was indicated, and with this indicator, after a little experience, cooking became purely a matter of time, and could be done "by the clock." For many reasons it was desirable to heat the oven up quickly ; for an oven with a cooking space about 20 in. high × 15 in. wide × 18 in. deep the makers employed a 2½ to 3-KW. rating for the preliminary heating, which consumed about 1 B. of T. unit ; thereafter the temperature was maintained with about ¾ unit per hour, so that 2½ to 3 units would cook quite a big dinner, especially if the falling temperature of the oven was taken advantage of for cooking such things as milk puddings. A customer who used one of these ovens recently, stated that he had cooked a full dinner in 1½ hours with a consumption of 2 units, which was at least as cheap as could be done with gas.

MR. T. HARDING CHURTON, chairman of the Section, opening a discussion on the subject, said that Mr. Cridge had only communicated to them results of his own work, and had not attempted to speak of other results. He understood that there had been very little electric cooking done in Sheffield. It would be interesting if subsequent speakers would tell them about the efficiency of such apparatus. He had heard that 0·06 unit would raise 1 pint of water from 60° F. to 212° F. Information as to the life of the apparatus would be welcome.

MR. R. L. ACLAND (Chesterfield) said that the subject was one of special interest nowadays. He would be glad of information which would enable them to make comparisons with gas.

MR. F. S. GROGAN (Berry Construction Co., Ltd.) said that the calorific value of one pennyworth of gas at 2s. 6d. per 1,000 cb. ft. was six or seven times as great as that of a unit of electricity ; but as it took 5½ minutes to heat 1½ pints of water from 61° F. to boiling, and consumed gas at the rate of 2·44 cb. ft. per pint, the efficiency of gas heating was only 11·4 per cent. There were 685 heat units in 1 cb. ft. of gas. For equal results, then, the efficiency of electrical heating need only be 68·4 per cent., and in actual practice efficiencies of 80 per cent. and over were obtained in a Tricity kettle. A great point in favour of electric cooking was the excellence of the food when cooked. In standard cookery books they were told that from a quarter to a third of the weight of a joint of meat was lost in cooking. In the case of Tricity cooking, a 7-lb. joint which he had cooked only lost ½ lb. instead of 2 lb. Therefore, in addition to high efficiency and consequent low cost, there was a saving in meat, so that the housewife not only got the cooking for nothing, but was some 15 or 16 pence in pocket into the bargain. Mr. Grogan proceeded to point out the superiority of hot-plates over internally-wired kettles, irons, and pans, and pointed out that the stove was practically everlasting, and the utensils could

be cheaply replaced in the event of accident or when worn out, whereas with self-contained apparatus replacement was necessarily a much more expensive matter.

Mr. R. H. Schofield (Ferranti, Ltd.) showed an iron, a hot-plate, and the heating element for them, which his firm intended to place upon the market. In Canada and the United States these hotplates were in very general use, and people called them "stoves," and used them as such. He thought one should have plenty of mass in heating apparatus, to ensure durability, and so confident were his company in the excellence of their idea, that they were prepared to replace irons and hotplates complete if the heating element broke down within two years. He thought that central station managers were not altogether on right lines with tariffs. In Bradford and Southampton there was an extremely low running charge, and a first charge of a fairly high order. He thought apparatus should be hired out. People would rather hire apparatus and pay 2d. per unit than buy it and pay ½d. per unit.

Mr. I. F. Fawcett (Leeds) said that there had been electric cooking in 1902, and also radiant heat baths. The subject had been brought to the front now, because supply authorities had been so badly hit by metallic lamps, that they had to seek ways of bringing up the revenue. Had they wished, years ago, they could have encouraged manufacturers to produce apparatus earlier, and to have perfected it. In pushing the sale of such apparatus, lady canvassers often proved useful.

Mr. Morrison (Electric and Ordnance Accessories Co., Ltd., Birmingham) thought that it was advisable to follow on the lines of the designers of gas cookers, and to make strong, durable, and cheap cookers. Imitation of gas authorities should be carried further, and supply authorities should hire the goods out.

Mr. H. E. Yerbury (chief electrical engineer, Sheffield Corporation tramways) hoped that shortly it would not be necessary to have a special circuit for heating, nor special apparatus for it. He thought the proper way to proceed was to make an inclusive charge, to cover hire of apparatus and energy used.

Mr. H. A. Howie (Sheffield) thought that the manufacturers, if confident of their goods, should sell to consumers by hire-purchase, instead of asking the undertakers to do so. He favoured the Norwich method of charging, which would enable them to use one circuit for any purpose, and thus to realise Mr. Yerbury's suggestion.

Mr. Wilson Hartnell (Leeds) said that Mr. Fletcher, of Warrington, obtained 300 heat units per cb. ft. of gas from his burners. He, himself, had obtained about 150. Mr. Grogan did not appear to have obtained so much. His own experience was that about 12½ cb. ft. were required to cook a dinner, and 1¾ cb. ft. to make a round of toast.

Mr. W. F. Mylan (British Westinghouse Electric and Manufacturing Co., Ltd., Sheffield) was doubtful of the durability of the apparatus, and also of the economy of electric cooking.

Mr. Harold Dickinson (Leeds) thought that if there need only be one circuit, it would be a great improvement. It was not altogether the pressure of metal lamps that had caused supply authorities to be keen on heating. They had not been able to get the benefit of cheap production costs until the power load developed. In the early days of lighting, charges and costs were high, and they only got those customers who would have electricity because of its other advantages. As costs came down, so prices decreased, more customers came, and revenue grew.

Mr. Cridge, in reply, doubted the wisdom of employing very large masses for durability, as Mr. Schofield had suggested. Masses took energy to heat them, as fly-wheels did to turn them. Mr. Fawcett was not quite fair to central station engineers when he suggested that the metal lamp was the cause of their present attitude. There had been a great deal of what must be called rubbish put forward in the past by manufacturers, and undertakers must be quite sure of the worth of goods before they could push them. They had to live with their customers. He agreed with Mr. Dickinson, that lower costs had eased matters for them. In the first years of any business, customers were obtained who would pay any price for the advantages. They had to tap in succession lower and lower strata of revenue-earning material by means of lower prices. He did not altogether agree with Mr. Morrison that they must follow gas designs. The bright, shiney, thin-walled Tricity oven was, as a scientific fact, quite as efficient in retaining heat as a heavily lagged oven.

There was a large and representative collection of modern heating and cooking apparatus exhibited in the lecture theatre, including a Tricity range and Eclipse stove, and other miscellaneous articles.

Control of Electric Winding Engines.

(*Discussion on paper read by* Dr. E. Rosenberg, *before the* Institution of Electrical Engineers *at Manchester, December 6th*, 1910. See Elec. Rev., December 16th.)

The Chairman (Mr. J. S Peck) said that with the usual A.C. winding engine there were two methods of braking available: (1) mechanically by means of brake blocks and (2) electrically by means of counter current. In lowering it was possible to let the motor run above synchronism, and so return power to the line, but this method was not available for lowering at low speed or for stopping the motor. Where the motor was used as a generator by exciting the stator with D.C. it was impossible to brake with counter current whilst the motor was generating, which was also an objection to this method. With the eddy-current brake or with any other type of external brake, such as a water brake, it was possible to use the mechanical brake, counter current and the external brake simultaneously. The external brake also gave a highly satisfactory method of lowering at reduced speed. Whilst an eddy-current brake for a low-speed motor was an expensive machine, and although the inertia of the rotating parts added appreciably to the power required for acceleration and retardation, there seemed to be a demand for it, and under certain circumstances its use was quite justifiable.

Mr. W. Cramp said the author had referred to commutator motors as not being so efficient as other motors; yet to obtain braking effect, he did not hesitate to recommend a special rotary converter with a commutator. For the purpose discussed in the paper, there was a possibility of employing a system which Dr. Rosenberg had not mentioned—viz., an induction motor with a variable number of poles. The only objection to the use of the induction motor as a brake seemed to be that without counter current it was only suitable for speeds a little over synchronism. If it were arranged to have the number of poles changed it might be used as a brake down to the speed corresponding to the largest possible number of poles, or the winding of the motor might be arranged so that it could be connected in cascade, with a very wide range of regenerative braking.

Mr. J. Frith had used eddy-current brakes with external iron wheels and an ordinary alternator field a good deal for ordinary testing work; they were most convenient and flexible appliances, and he found that the torque went on increasing with the speed. The path of the eddy currents was so undefined that their reaction on the field magnets was very slight. To direct the eddy currents, he had slottted the iron and put on a copper squirrel-cage winding in good electrical contact throughout with the iron, but had got better results by employing the copper end rings only without axial bars. He had used this method of braking small induction motors, using one phase in series with the other two in parallel to carry the D.C.

Mr. T. Fergusson said it was most important to consider the subject of braking methods before giving preference to any one system of control. In electric winding, the final choice might be determined by the question of efficient and safe braking. The system of braking which would appeal most to the user would be the counter-current method, although it might not be very good commercially when lowering loads for a considerable time. In that case the Ward-Leonard system might be preferable. The eddy-current brake offered considerable safety and ease of manipulation. If, for example, a balance rope were fitted to the cages, the static torque became uniform throughout the wind, and it was an easy matter to switch on the eddy-current brake, starting the load downwards by a short application of power, and bringing the control lever back to the "off" position; the load would then descend at a uniform rate under the action of the eddy-current brake, and finally, pulling the control lever backwards would bring the load to rest by the application of counter current.

Mr. A. B. Mallinson considered that colliery proprietors would be inclined to condemn large eddy-current brakes when considering electric power for winding from deep shafts. One of the first requirements was that power must be returned to the line whenever possible. The electric winding engines which he had seen in operation were small, compared with the high-class steam winding engines at large South Wales pits. When electric winders of similar duty were put to work, the losses between winds (due to running fly-wheel sets) would be so reduced that D.C. winders with a fly-wheel converter would show an overall efficiency better than would be obtained with A.C. winder equipments.

Mr. A. F. Stevenson thought that they need only consider colliery winding plants supplied from power companies' mains, the capital expenditure involved making it impossible to get them installed otherwise. The rheostatic method of control applied to a three-phase motor on the power supply mains appealed to him as the most suitable for colliery conditions, the checking and adjusting of the cage position being done by counter current in the same way as steam was used.

Mr. W. Shaw found that in the case of a small haulage motor the current rose to a high value, even if full resistance were switched into the rotor circuit in the interval between opening the switch and closing in the reverse position. Unless energy was returned to the line, the only argument in favour of electric braking was that it, perhaps, would lend itself to lighter and more easily regulated control apparatus than the mechanical friction brake now in use on steam winders. Colliery managers would prefer to put up with the friction brake, in which they felt confidence, rather than go to the expense of an electric brake.

Dr. E. Rosenberg, in reply, said that in order to get good commutation in a single-phase machine, the voltage between the bars must be low, and to build an armature for low voltage and high current was expensive. Besides, the efficiency of the single-phase motor was lower than that of either D.C. or three-phase motor. The pole-changing device could be used to get an economical running at half speed and to lower men by running the motor with the double number of poles a little above synchronism. The practical objection against doing this with large direct-coupled winding motors was the great number of poles required, and the deterioration in performance which such an arrangement of stator and rotor coils would give even at full speed. For English coal mines the eddy-current brake would hardly ever be required. He had seen mines where winding coal and men was done at the same speed, and trips with an unbalanced load were of rare occurrence; in such cases the expense for the eddy-current brake would not be justified. Replying to Mr. Shaw, rushes of current on reversal would not happen if the controller was properly designed for this service.

Submarine Cables for Long-distance Telephone Circuits.

By MAJOR W. A. J. O'MEARA, G.C.M., M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS, *London, December 15th*, 1910.)

THE first submarine cable of any length specially designed and provided for telephonic purposes by the British Post Office was that between St. Margaret's Bay and Sangatte, laid in 1891, to provide telephonic facilities between London and Paris. Since then, many other cables have been laid, all practically of the same type. The weight of copper and gutta-percha in the cores was so proportioned as to make them specially suitable for use in connection with considerable lengths of land wires. The Port Mora-Donaghadee cable, for example, connecting the English and Irish telephone systems, forms a link between 400 or 500 miles of landline on each side. The data available in 1890, when the first Anglo-French cable was designed by Mr. H. R. Kempe, now electrician to the British Post Office, were naturally somewhat incomplete, but the results obtained with the first telephonic circuit between London and Paris have proved eminently satisfactory from the date of its first use. This has been testified to by the demand of the public, not only for additional facilities between England and France, but also for the establishment of telephonic communication between England and Belgium. In the latter case facilities were provided in the year 1902.

I was serving as a subaltern in the 2nd Division Telegraph Battalion Royal Engineers (now "K" Company R.E.) in 1890, and was charged with the duty of making all the necessary arrangements for the selection of a suitable route for the lines from London to the coast, the preparation of the estimates and the superintendence of the construction of the works necessary on this side of the water.

The laying of the first cable (constructed by Messrs. Siemens Bros. & Co.) was carried out by H.M.T.S. *Monarch*, under the command of the late Mr. D. Lumsden. Descriptions of the cable have already been published.*

It was well known some 50 years ago that the high electrostatic capacity of gutta-percha-covered conductors greatly affected the transmission of electric impulses, but it was not until 1887 that a satisfactory theory of telephonic transmission was formulated. In that year, Oliver Heaviside† gave the essential parts of the theory of telephonic transmission, pointing out the importance and beneficial effects of self-induction, and stating the relation which must exist between the constants of a circuit in order that electrical waves of all frequencies may be transmitted without distortion. To him most certainly belongs the credit of being the earliest investigator in the field of telephony to predict the measures necessary for progress in the art of speech transmission.

So far back as 1891 Silvanus P. Thompson obtained a patent for the employment of distributed inductances, leaks, &c., and this patent specification may be considered to have afforded independent testimony to Heaviside's views. Engineers, however, were not convinced as to the practicability of effecting improvements in telephonic transmission by this means, and therefore a solution to the problem was sought by devising a method for materially reducing the electrostatic capacity of submarine cables. The air-space type of cable designed by Messrs. Willoughby S. Smith and W. P Granville was, in 1897, brought to the notice of Sir William Preece, then engineer-in-chief to the British Post Office. The extension of the telephone trunk service to the Isle of Wight had just been sanctioned, and was provided by an air-space cable laid between Stone Point and Gurnard Bay, a distance of about two knots, on June 30th, 1897. The tests carried out when the cable was laid proved it to be in every way satisfactory. It was discovered later, however, that this apparent freedom from defects was due to the fact that the cable was of too short a length for a complete investigation of its telephonic efficiency to be made. When an increase in the number of telephone circuits between England and Ireland was suggested in 1898, this type of cable was adopted for the purpose.

When this Anglo-Irish cable was tested under practical conditions, a very serious defect was discovered—namely, that serious inductive disturbances existed between one pair of conductors in the cable and the other pair. Great disappointment was experienced when this fact came to light, and to clear up the situation a series of experiments was arranged in 1900 by Mr. (now Sir) John Gavey on the three cables (two telegraph and one telephone) which at that time connected Nevin, in Wales, and Newcastle, Co. Wicklow. The following conclusions were drawn from the experiments :—

1. Commercial telephonic communication between terminal points connected by a 60-knot length of the ordinary submarine telegraph cable of the standard type is possible, but there is no margin available under such conditions for extending the range of communication beyond that distance.

2. The air-space type of cable of a similar length—60 knots—does afford a sufficient margin for extending the range of telephonic communication very appreciably if combined with suitable aerial conductors, but the existence of overhearing between the two pairs of conductors, and the disturbances introduced by utilising one pair of wires for telephonic purposes and the other two wires simultaneously for high-speed telegraphic purposes, preclude the employment of this type of cable for telephonic purposes wholly, or for joint telephonic and telegraphic purposes, unless the telegraph circuits are impeded and worked at a low speed.

There appears to be little doubt that the failure of this type of cable is due wholly to the difficulty in manufacturing it in such a manner as to ensure that the centres of the conductors shall form at every cross-section a true square.

When the question of laying an Anglo-Belgian cable in order to establish direct telephonic communication between London and Brussels came up for consideration, it was decided, in view of the failure of the air-space cable, to use the same type as the original Anglo-French cable.

In 1908, in view of the demand for additional telephone facilities, it was decided to provide four additional circuits (*i.e.*, two new cables) between England and France, each country providing and laying one.

The opportunity was taken to extend the range of intercommunication so as to embrace centres not hitherto included in the international zones, owing to the great distances separating them.

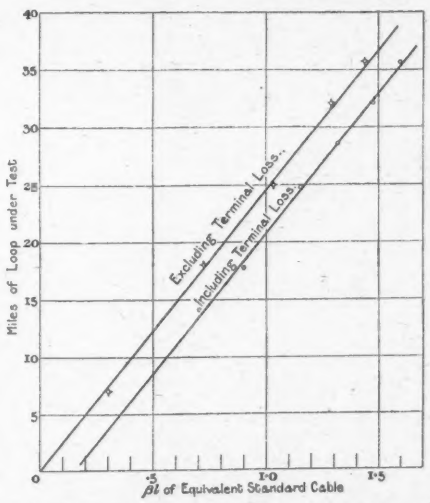
Three methods of increasing the range of telephonic transmission, so far as submarine cables are concerned, have been prominently before the engineer-in-chief's staff, viz. :—

(*a*) By the use of heavier copper conductors, and by an increase, at the same time, of the separation between them.

(*b*) By the provision of one or more closely arranged layers of suitable iron wire over the whole length of the copper conductors in the cable—the so-called "continuous" loading system.

(*c*) By the introduction at regular intervals of suitably arranged inductance or loading coils—the so-called "non-continuous" or "coil" loading system.

Two varieties of cable in which it was proposed to obtain increased efficiency in transmission by the employment of a larger quantity of copper per unit of length have been submitted to the Engineering Department ; in both designs provision has been made



Length, 1·78 miles. Type, 4 quads + 12 pairs. Copper, 2 mm². Iron, one layer 0·37 mm. wire. Loop resistance per mile, 27·64 ohms. Wire-to-wire capacity per mile, 0·08 microfarad. Inductance per mile, unknown.

FIG. 1.—EFFICIENCY TESTS OF "CONTINUOUSLY" LOADED CABLE.

for the introduction of layers of paper between the copper and the gutta-percha, and each contains only a single circuit. Paper appears to be a somewhat unsuitable material to employ in the manner proposed on account of its hygroscopic qualities, which cause it to absorb moisture from the gutta-percha, quite apart from the question of the probable high cost of maintenance that a cable in which paper is used may involve.

The magnitude of the capital cost involved in providing the cables rises in a nearly geometrical ratio if the problem is solved by the simple expedient of increasing the weight of the copper conductors, and for this reason proposals for heavier copper conductor types of cable have in recent times been in abeyance.

The two practical methods—that of "continuous" loading and that of "non-continuous" loading—have therefore been the only ones considered. A schedule is given in an Appendix of some foreign loaded submarine telephone cables which have been provided in the past. The "continuously" loaded type of cable appears to offer an advantage as being mechanically simpler than the "coil" loaded cable, but our investigations have shown that the increase in efficiency which it was desired to obtain could only be realised at an incommensurate cost. Moreover, it has been found that it is not possible to predict with sufficient accuracy, by mathematical calculation, the results likely to be obtained by the "continuous" loading, owing to the difficulty in attaching correct values to the electrical constants involved.

Messrs. A. W. Martin and J. G. Hill, of the Post Office Engineering Department, recently carried out a series of comparative speech tests on a number of cables of this type by the kind permission of the late Mr. C. E. Krarup, Engineer-in-Chief to the Danish Telegraph Service. The results obtained on one of these cables are shown graphically in fig. 1. The observed attenuation constant of another of the Danish cables is given in Table A, and for comparison therewith, the attenuation for the same cable as found by calculation, and the attenuations calculated for ideal cables with the same copper conductor are also shown (1) unloaded, and (2) loaded with inductance coils. The data given in Table B relate in

* ELECTRICAL REVIEW, Vol. 27, page 309, 1890, and Vol. 29, page 247, 1891.

† *Electrician*, Vol. 19, page 79, 1887; Electrical papers, Vol. 2, page 119.

a similar manner to a cable actually loaded with inductance coils. A wide difference is seen to exist between the ascertained values for attenuation of "continuously" loaded conductors and those which theory seems to predict.

The development of telephonic communication by means of conductors in comparatively long lengths of subterranean cables during the past few years has afforded the Post Office Engineering Department a valuable opportunity for making a close study of telephonic transmission under various conditions. Mr. H. R. Kempe has gone very carefully into the method of calculating the attenuation of telephone circuits and the cost aspect in regard to the design of gutta-percha cable.

TABLE A.

Based on actual "continuously" load cable.
Overall diameter of copper, 126 mils.

Loading.	Outer diameter of gutta-percha. Mils.	β 1/knot	
		Observed.	Calculated.
Three layers of 7·88 mils iron wire	355	0·0296	0·0197
Unloaded	355	—	0·0369
Coils of 100 millihenries every 1·075 knots	335	—	0·0148

TABLE B.

Based on actual "coil" loaded cable.
Overall diameter of copper, 106·2 mils.

Loading.	Outer diameter of gutta-percha. Mils.	β 1/knot	
		Observed.	Calculated.
Coils of 100 millihenries every knot	390	0·0166	0·0166
Unloaded	390	—	0·0766
Three layers of 7·88 mils iron wire	405	—	0·0241

Our investigations clearly indicated that it was possible to obtain more appreciable improvements in long-distance telephone cables by employing loading coils than by resorting to the "continuous" loading of the conductors. Therefore when the matter of the provision of additional submarine cables between this country and France was referred to the Engineering Department, inquiries were at once made to ascertain whether it would be practicable to provide, lay and maintain in a satisfactory manner, a submarine cable of the "coil" loaded type.

In order to be absolutely on the safe side, it was decided that the general design of the new telephone cable in respect of the copper and the dielectric should be exactly similar to the type already in use, which it was known would provide telephonic transmission of a certain quality, and that the improvement desired could be obtained by the contractors either by means of "continuous" loading or "coil" loading, the department simply stipulating in the specification that the attenuation constant should not exceed a certain definite value. The main reason for this was that if it had been discovered after the cable had been laid that coils introduced effects not foreseen, the coils could easily have been cut out at a small cost, and the department would still have had a cable as good as the existing one.

Selected firms were asked to tender for the additional cable to be provided by the British Administration. No tenders were received for the "continuous" type of loading, but three tenders were received for the "coil" type of loading. In each case the method of providing the increased inductance was different.

The features of the device for loading in the accepted tender are as follows:—

The two double coils required for the four conductors of the cable, each coil being of slightly less than 6 ohms resistance, and having an inductance of 0·10 henry at 750 periods per second, are inserted at intervals of 1 knot (1·153 miles), but the two coils nearest the ends of the cable are inserted at a distance of only half a knot from the terminal apparatus, as experiments have shown that in this arrangement reflection losses are considerably reduced. Each double coil consists of two windings on the same iron core, and one winding is connected in series with each conductor. By this means the gradual change in permeability in the iron core due to ageing, will not affect the balance in the two limbs of the telephone circuit. Each coil is protected with a sheet of metal foil in order to exclude all possibility of the silk covering of the wires of the coils absorbing moisture from the cylindrical envelope of gutta-percha in which they are contained. The cores of the cable are connected to the envelope at its two ends by tapered solid gutta-percha joints. The diameter at the centre of the envelope is 3 in., and at the cores where the joints terminate 1 in. An annular rubber distance-piece is inserted between the two coils of a set to give greater flexibility. The total length of the joint is 30·75 in. As the diameter of the cable at the points where the coils are inserted is increased, a larger number of sheathing wires are required at those points than over the conductors alone. This difficulty is ingeniously overcome by starting a second layer of sheathing wires over the cores, about 27 ft. from the centre of the coil envelope and gradually working them into a single layer with those over the bulge. Finally they are terminated as a second layer again over the cores at a distance of about 27 ft. from the centre of the coil envelope. The method adopted in inserting the coils (Patent Specification No. 5,547 March, 1907) will perhaps be understood from the diagrams (fig. 4).

The mechanical problem in connection with this type of cable was more difficult to solve than the electrical problem, as it was necessary that the part of the cable containing the coils should be so designed that it could be paid over the sheaves of the cable-ship without any risk of damage to the coils themselves. The manufacturers succeeded in solving this problem in a most satisfactory manner.

The cable was under the constant supervision of the Post Office Engineering Department during the period of its manufacture, and electrical tests were carried out from time to time. On January 18th, 1910, after the completion of the cable, measurements to determine its attenuation constant were made at the works of Messrs. Siemens Bros & Co., at Woolwich. The conductors of the cable were joined up so as to provide a metallic circuit of 41·704 knots, and in order to get rid of terminal effects artificial cable was joined to the ends of the loaded cable thus:—

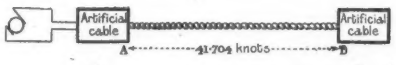
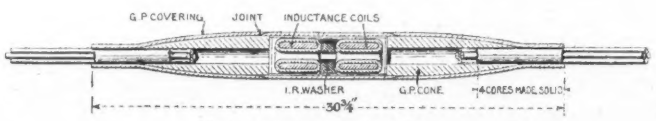


FIG. 2.

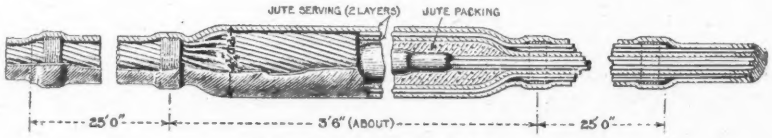
Current was supplied to this circuit by a generator giving 1·585 volts at a frequency of 750 alternations per second. Readings were taken on a thermo-galvanometer placed successively at A and B, and the attenuation constant was calculated by the formula $C_B = C_A . e^{-\beta d}$.

With 10 miles of "standard" cable (attenuation constant 0·1187 per knot) at each end of the circuit, the current values at A were found to be 0·327 milliampere, and at B 0·172 milliampere, β therefore being 0·0154.

FIG. 3.—SECTION OF CABLE CONTAINING LOADING COILS, COMPLETE WITH SHEATHING WIRES.



ARRANGEMENT OF COILS IN CABLE



METHOD OF SHEATHING OVER COILS

FIG. 4.—ANGLO-FRENCH CABLE, 1910.

With 15 miles of "standard" cable at each end of the circuit the current values at A were found to be 0·212 milliampere; at B, 0·110 milliampere, from which we simply obtain $\beta = 0·0152$.

The volume of the speech transmitted over the loaded cable was also compared with that over an artificial "standard" cable, the electrical constants of which are known. The results of these tests indicated that the attenuation constant of the loaded cable was 0·0147.

If the electrical constants of the Anglo-French loaded cable are substituted in the formula—

$$\beta = \tfrac{1}{2} (R + S/K . L) \sqrt{K/L},$$

it will be seen that the attenuation constant obtained by the sent-and-received current test requires that the value to be assigned to S/K in the above formula must be approximately 99, whereas the value of the attenuation constant indicated by a comparison with the artificial "standard" cable requires the value of S/K to be 80. There is no doubt that leakage plays a very important part in the transmission of telephonic speech. Recently, whilst in America, I found that one of the principal difficulties which had been encountered in that country in connection with the loading of long

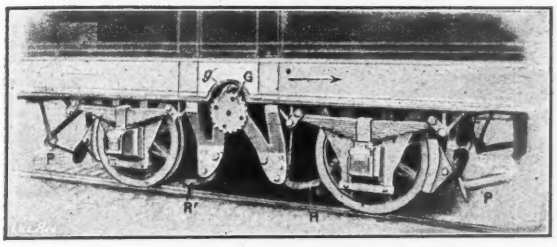
distance aerial telephone circuits consisting of the larger gauges of wire was chiefly due to leakage. The difficulty has been largely overcome by the substitution of more efficient insulators for the glass ones which have hitherto been in general use in the United States.

(To be concluded.)

A NOVEL TRAM-RAIL CLEANING METHOD.

That there is no point which may be neglected in the successful and economical working of a tramway system is seen in the care which is taken by many companies in keeping the rails of their lines free from dust and dirt. In most cases this is done by the somewhat crude plan of sending men along the track pushing before them in the groove of the rails a long iron bar, which displaces the mud and dirt that may have collected therein.

At best this is a very unsatisfactory method, as the mud and dirt are merely laid at the side of the rail or road and quickly find



G, g, Ratchet wheel and ratchet by which the rail-clearing knives R R¹ are regulated: P, Water distributing roses.

Fig. 1.—Details of the Rail-Clearing Mechanism on the Dust and Dirt Collecting Car in use on the Tramways at Hanover.

their way back to the rails. It has remained for the engineer of an electric tramway system in Germany—that at Hanover—to tackle the problem in a scientific way.

To this end he has recently put into service the special tramcar shown in the accompanying illustrations—for which we are indebted to "Omnia." As will be seen, the vehicle is fitted with two pairs—there being a set on each side of the car—of pivoted

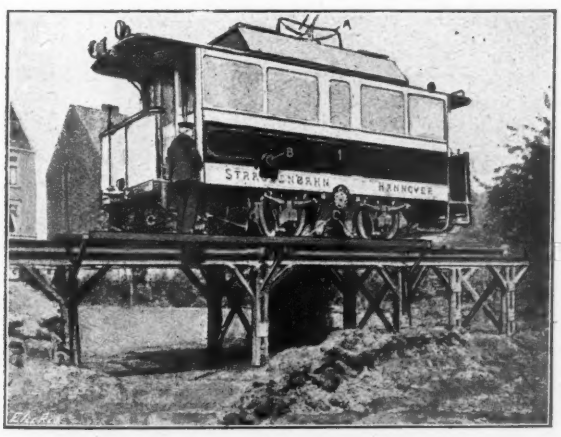


Fig. 2.—The Rail-Clearing and Dirt Removal Car in Service in Connection with the Tramway System at Hanover. The illustration shows the vehicle on the elevated track in the dust yard, where it discharges its load of mud and dirt.

blades or knives which run in the grooves of the rails and displace the mud and dirt as the vehicle travels rapidly along.

This is, however, only a part of the scheme; the novel feature lies in the fact that mounted on the car is an electrically-operated vacuum suction plant, which draws up the mud and dirt from the lines to a receptacle on the car, much in the same way as the dust is extracted from carpets, &c., by the vacuum cleaning plants familiar in this country.

The dirt-collecting receptacle has a capacity of four cubic metres, stated to be sufficient to receive the scrapings from 10 kilometres of track. When the receptacle is full, the car is driven to the company's dust yard where a special line has been constructed to enable the contents of the receptacle to be discharged from below.

The capacity of the suction plant is stated to be sufficient not only to remove the dust and dirt, but also any small pieces of wood and stones that get embedded in the rails. The car is also provided with a couple of water tanks with distributing jets near each wheel, so that, on dusty days, the dust may be wetted and removed with a minimum of discomfort to the public.

One great advantage of the new system is that it enables the track to be kept clean without in any way interfering with the traffic on the line, and, it is claimed, at a minimum cost.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SOUTH AFRICA.—*(Concluded.)*

The following goods are admitted free of duty:—Brass and copper in bars, ingots, plates and sheets; cranes, elevators, &c.; graphite; india-rubber unmanufactured; machinery, apparatus and appliances, and electrical material used in connection therewith, for the generation, storage, transmission, distribution of, and lighting by, gas or electric power (including conduit piping but not including electroliers, hand lamps or fancy fittings); locomotives; telegraph and telephone materials and instruments for use in construction and working of telegraph and telephone lines; electric accumulators for all purposes; also electric magnetos, and parts thereof, imported separately; railway and tramway construction or equipment materials; public stores imported for the sole and exclusive use of the Government.

All other electrical machinery and apparatus:

Under the British Preferential Tariff	12 % ad val.
,, General Tariff	15 % ad val.

Note.—No person may, in the Cape of Good Hope, except expressly authorised by Act of Parliament, erect or make use of any mast, standard, or apparatus of any kind for the purpose of aetheric signalling without wires, by means of electricity, magnetism, electro-magnetism or other like agency, or erect or construct any line of electro-telegraph except under a licence to be granted by the Governor.

In Natal no person may, except on behalf of the Colonial Government, make, equip, or use within the Colony and station, machine, installation or apparatus capable of being used for the purpose of transmitting or receiving wireless telegrams.

As regards the Orange Free State, Basutoland or Bechuanaland Protectorate, no person may establish or use any apparatus or installation for the transmission of messages or other communications, by means of electrical energy, without the aid of wires, without having a licence, and there shall be payable in respect of such licence the sum of £100.

The value of goods subject to *ad valorem* duty is the true current value for home consumption in the open market for similar goods at the *place of purchase* bought in the ordinary manner from the manufacturer or supplier in normal quantities, including the cost of packing and packages, but not including agents' commission if it does not exceed 5 per cent.; provided that in no case shall the true current value, as above defined, be less than the cost of the goods to the importer at the place of purchase.

Turin Exhibition.—A beautiful model is at present to be seen at the Exhibitions Branch of the Board of Trade. This is a perfect representation of the buildings in the British Section at the Turin International Exhibition, which is to be opened on April 29th by his Majesty the King of Italy. The miniature is just $\frac{1}{500}$ the actual size, and is complete in every detail. Thus the Machinery Hall, 158 ft. 4 in. long, is in the model only 10 ft. 6 in. The magnificent façade, which from the lovely Valentino Park looks down upon the historic river Po, and confronts the sections held under the auspices of various Great Powers, on the model is 13 ft. long, but in reality has a graceful sweep of 650 ft. The 3-ft. height of the tallest tower represents 150 ft. in the actual building, while the central and supporting domes of the main façade are each 200 ft. high. By Great Britain the superficial space occupied is, roughly, 5 acres—much more than that taken up by any of her commercial rivals—and the site, for picturesqueness, and, what is much more important, for commercial value, is the finest in the Exhibition grounds. We are glad to know that British exhibitors anxious to participate in the new markets which Italy is opening to the world—especially in the way of textiles, machinery and machine tools—are making a great effort to eclipse the recent Brussels Exhibition. We have received from the offices of the Commission in London a printed summary of the classifications adopted for this Exhibition.

NEW PATENTS APPLIED FOR, 1910.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

28,226. "Improved process for the production of iron by electro-deposition." S. O. Cowper-Coles. December 5th.

28,236. "Improvement in the sound of telephones and the like." W. R. Bigsby-Chamberlin and H. G. Watson. December 5th.

28,251. "Improvements in connection with the mounting and electric driving of gramaphones and the like musical instruments." C. T. Pressland and W. T. Pressland. December 5th.

28,272. "New or improved rotary magazine electrical fuse." W. G. L. Riddle and L. Smith. December 5th.

28,307. "Reversible variable speed dynamo." J. Mould. December 6th.

28,332. "Thermo-electric motor." E. R. Rouse. December 6th.

28,356. "Improvements in or relating to electric searchlights." Siemens Schuckertwerke G.m.b.H. (Date applied for under Sec. 91 of the Act, January 26th, 1910, being date of application in Germany. Application for Patent of Addition to No. 8,411, 1910.) December 6th. (Complete.)

28,368. "Improvements in or relating to telephone call recorders." A. J. Boult. (H. S. Mills, United States.) December 6th. (Complete.)

28,382. "Improvements in magnetic blow-outs for electric arc lamps." A. Bisson and G. Berges. (Date applied for under Rule 18, May 17th, 1910. An invention comprised in application No. 12,149, dated May 17th, 1910.) December 6th. (Complete.)

28,385. "Improvements in and relating to holders for incandescent electric lamps and the like." J. Bein. December 6th.

28,397. "Improvements in guards for telephone transmitters." F. Gottschalk. December 6th. (Complete.)

28,419. "Improvements in electrodes for electric storage batteries." P. J. Kamperdyke. (Date applied for under Sec. 91 of the Act, December 6th, 1909, being date of application in United States.) December 6th. (Complete.)

28,457. "Improvement in electric connections and focussing arrangement for electric motor lamps." C. H. Worsnop. December 7th.

28,476. "Method of abtaining diffused light radiation from artificial sources of light." Union Electric Co., Ltd., and J. Roberts. December 7th.

28,477. "Apparatus for removing scale from the tubes of steam generators specially applicable for use in connection with ships' boilers, locomotives, locomobiles and compound boilers." Electric Safety Boiler Cleaner, Ltd., and A. Schror. December 7th. (Complete.)

28,478. "Improvements in apparatus for removing boiler scale and the like." Electric Safety Boiler Cleaner, Ltd., and A. Schror. (Application for Patent of Addition to No. 16,336, 1908.) December 7th. (Complete.)

28,501. "Improved construction of rotary electric switch specially applicable for controlling the electric lamps of motor-cars." A. A. Price. December 7th.

28,521. "Electric lampholders." B. Kay. December 8th.

28,530. "Improvements in or relating to electric conductors for the transmission of variable currents or impulses." W. E. Hitch. December 8th.

28,536. "Improvements in or relating to electrodes for electric furnaces.' M. Ruthenburg. December 8th.

28,544. "Improvements in electric lamp fittings." R. Anderson. December 8th.

28,552. "Electrifying process which may be applied to the various operations relating to textile and other materials." J. L. Paillet, F. Ducretet and F. Roger. December 8th. (Complete.)

28,555. "Improved electrically-operated indicating or recording apparatus for weighing machines or the like." J. H. Round. December 8th.

28,556. "Improved electrically-operated indicating apparatus for weighing machines or the like." J. H. Round. December 8th.

28,567. "New or improved construction of sparking plugs for internal combustion engines." A. E. Chapman. December 8th.

28,588. "Improvements relating to electric relay apparatus." Westinghouse Brake Co., Ltd. (J. D. Taylor, United States.) December 8th. (Complete.)

28,592. "Improvements in apparatus for use in the electro-deposition of iron." S. O. Cowper-Coles. December 8th.

28,611. "Improvements in electric current generators." A. E. R. Bottone. December 8th.

28,612. "Improvements in electric current generators." A. E. R. Bottone. December 8th.

28,613. "Improvements in electric current regulators." J. S. Goodwin, J. A. J. Haslop and T. H. Brown. December 8th.

28,657. "Improvements in mercury-contact electric switches." P. Meyer Akt.-Ges. and E. Kuhnel. December 9th. (Complete.)

28,661. "Improvements in or relating to the reversing of polyphase electric motors." Siemens Schuckertwerke G.m.b.H. (Date applied for under Sec. 91 of the Act, December 11th, 1909, being date of application in Germany.) December 9th. (Complete.)

28,668. "Improvements in and relating to thermo-electric generators." P. Ferra. December 9th.

28,669. "Improvements relating to the generation of electric current." P. Ferra. December 9th.

28,686. "Improvements in the transmission of the elevation to the several guns of a ship or of a battery." E. Schneider. December 9th. (Complete.)

28,687. "Improvements in or relating to overhead systems for transmitting electricity." J. Paul. (Date applied for under Sec. 91 of the Act, December 21st, 1909, being date of application in France.) December 9th. (Complete.)

28,695. "Improvements in or relating to electric lighting and like systems." Leeds Forge Co., Ltd., and T. Ferguson. December 9th. (Complete.)

28,700. "Means for verifying the operation of apparatus for distant electrical transmission and control of operations." E. Schneider. December 9th. (Complete.)

28,720. "Improvements in or connected with hose-pipes for electrically-controlled vacuum cleaning apparatus and the like." T. H. White. December 10th.

28,724. "Improvements in electric lighting." I. Frankenburg & Sons, Ltd., and E. Fleming. December 10th.

28,752. "Improvements relating to freely suspended electric lamps." H. B. Sale. December 10th.

28,754. "Improvements in dynamo design and construction." G. Inrig and Gavin Inrig, Ltd. December 10th.

28,755. "Improvements in secondary batteries." G. Inrig and Gavin Inrig, Ltd. December 10th.

28,775. "Improved device for replacing electric fuses." H. Peace. December 10th.

28,783. "Wooden propellers for aeroplanes and the like with an electrically-deposited metal coating." H. C. Barber. December 10th.

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of Messrs. W. P. Thompson & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1909.

Electrically Driven Centrifugal Machines. R. Macfarlane. 26,406. November 15th. (Cognate application, No. 5,178 of 1910.)

Galvanic Batteries. J. E. Preston. 26,683. November 17th.

"Four-way" and "Off" Electric Light Switch. E. Bourne. 26,899. November 19th.

Magneto-Electrical Machine. W. H. Turner and G. Fenwick. 27,624. November 27th.

Electric Propulsion of Ships. Siemens Bros. Dynamo Works and E. A. Holmes. 28,804. December 9th.

Wall and like Plugs for Electrical Connections. A. Bonnella and G. J. Bonnella. 29,603. December 16th.

1910.

Electric-Magnetic Relays. G. H. Nash and Western Electric Co. 752. January 11th.

Art of Rejuvenating Storage Batteries. A. C. Tate. 2,513. February 1st.

Rheostats. Adams Manufacturing Co. (Cutler-Hammer Manufacturing Co.) 2,749. February 3rd.

Electric Ignition Devices for Internal-Combustion Motors. Etablissements de Dion Bouton. (Soc. Anon.) 3,810. February 10th. (Date applied for under International Convention, August 26th, 1909.)

Method of Supplying Electric Furnaces with Triphase Currents. Soc. Anon. Electrometallurgique. (Procedes Paul Girod.) 3,421. February 11th. (Date applied for under International Convention, August 26th, 1909.)

Controlling Devices for Electric Motors. C. Henkel. 3,847. February 16th.

Hand Tool for Grinding and Cleaning the Commutators and Slip-Rings of Electric Generators and Motors. T. Taylor. 4,724. February 25th.

High-Frequency Ignition Apparatus for Internal-Combustion Engines. H. J. Haddan. (L. B. Lesperance, U.S.A.) 6,650. March 16th.

Device for Closing an Electric Circuit Automatically at a Temperature Variable at Will. F. E. Bourck. 9,864. April 18th.

Method for the Production of High-Frequency Currents for use in Wireless Telegraphy and Telephony. R. Goldschmidt. 11,294. May 7th.

Electric Furnaces. J. Thomson and F. M. J. FitzGerald. 11,717. May 11th. (Date applied for under International Convention, May 13th, 1909.)

Time Limit or Retarding Devices for use in Connection with Electric Circuit Breakers. Electric and Ordnance Accessories Co. and N. Collins. 12,708. May 25th.

Electric Circuit Breakers. British Thomson-Houston Co. (General Electric Co., U.S.A.) 13,520. June 3rd.

Process for Decarbonising Filaments for use in Metallic-Filament Glow Lamps. Wolfram Lampen Akt.-Ges. 14,116. June 10th. (Date applied for under International Convention, June 25th, 1909.)

Hydro-Electric Works in Switzerland.—According to a statement placed before a meeting of the Swiss Water Economic Union, held recently at Basle, the gross water power available in Switzerland amounts to 1,200,000 H.P. Down to the end of 1908 the quantity in use was 400,000 H.P., and this will soon be increased to 700,000 H.P. by the works now in progress. The object of the union is the protection and advancement of the whole water economic interests of the country. The dilatory policy of the Swiss Federal railways in regard to the reserving of water powers in connection with the electrical operation of the railways was severely criticised at the recent conference, and it was also mentioned that when offered a supply from the Laufenburg works which are now in progress the railway authorities did not even take the trouble to reply. On the other hand, the Baden (Germany) State railways at once arranged to secure a certain amount of power from the same works for railway purposes. The question of expropriation of certain existing works by the cantonal or local authorities is also engaging attention in Switzerland. The Grand Council of St. Gall has, for instance, just decided to acquire the majority of the shares in the Kubel electricity works and the power distributing network in the Upper Rheintal, and the State is also to take over the Rheintal electricity works in the near future.

Battery Cars for Railways.—An extension of the use of storage battery cars is being made in the vicinity of Frankfort-on-Main by the Prussian-Hessen State railway authorities, who already possess over 100 motor coaches of this kind for handling traffic on different parts of the railway network. The coaches are used as substitutes for passenger trains which were not well patronised, or for establishing a connection where the passenger train service was only carried on at long intervals. The new battery cars, which are now being placed in operation in the neighbourhood of Frankfort and Upper Hessen, are provided with six axles instead of four in order to secure a more equal distribution of the weight which is said to be 66 tons per double car, each car being composed of two halves closely coupled and intended for two classes of passengers. The cars are equipped with two motors of 60 H.P. each and are able to attain a maximum speed of 37 miles an hour, the accommodation for passengers ranging from 100 to 130 persons. The contractors for these particular coaches were the Felten & Guilleaume-Lahmeyer Works, the Berlin Accumulator Works Co. and Gastell Brothers. The batteries are located in an extension of the car instead of being placed in the interior as formerly, so that acid fumes can no longer cause inconvenience to passengers; one coach of this type was on view at the recent Brussels Exhibition.